Electrical World

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, January 10, 1920 *Number* 2

Financial Aid Needed

IN THESE piping times of peace, when the purchasing power of the dollar has shrunk immensely and organized labor, restive under the conditions, has demanded and secured added compensation, it is inevitable that somewhere injustice prevails. This is not always due to intentional slight. In fact, it is more often attributable to oversight and lack of appreciation of the true status of affairs. Nevertheless, one very important part of society, comprising professors, schoolmasters, professional engineers and others in non-speculative and non-commercial pursuits, is being slowly ground to dust because of this neglect. Our great educational institutions and engineering societies find themselves unable to function without increased financial support. The government itself is losing from its service large numbers of technically trained men because these men cannot live on the salary the government pays. The same is true in our colleges and universities; professors and instructors are going elsewhere, where higher salaries obtain, in order to survive. Now, these institutions and societies and trained men are vitally essential to the nation and our civilization, and it will be a lasting disgrace if the hampering conditions are permitted to continue. The most thrifty and most self-sacrificing class in the whole country must not be called on to bear huge burdens unaided, and the institutions which represent the real backbone of the intellectual side of the race and make up its moral fiber must be sustained.

Profiteering is no less unjust to the public where capital and labor are agreed upon the division of the spoils than where either interest has the economic jug by the handle. Just wages, fair profits and reasonable prices form an equilateral triangle which cannot be thrown out of shape as long as all the parties in interest give and take in full recognition of one another's rights.

Another Big Western Project

THAT the West, despite tremendous expansion of industry in the last decade, still has vast engineering projects in immediate contemplation is proved by the petition of the Kern Delta Irrigation District, California, for the right to appropriate 2,000 second-feet of the flood waters of the Kern River and its tributaries. The development planned is very extensive, including as it does the construction of a dam to cost $15,000,000 at the junction of the Kern River with its south fork, at Isabella, about sixty miles northeast of Bakersfield, center of California's petroleum industry. A reservoir possibly larger than that behind the Roosevelt Dam, Arizona, will be created as the result of this construction, for it is estimated by the applicants that 1,500,000 acre feet will be impounded. The development of 150,000 hp. is included in the present plans.

Whether the petition of the Kern Delta Irrigation District will be granted depends largely on the results of a survey of water resources of the Kern River system, now being undertaken by W. F. McClure, State Engineer, and Captain Charles H. Lee, president of the State Water Commission. The report will in all likelihood not be presented within less than a year, because of the necessity for intensive study of the conditions over a wide area. Nevertheless much attention is being directed to the proposal in the meantime, due to the magnitude of the project, for if carried through to completion it will take a prominent place among the engineering achievements of the Pacific Coast.

Under government ownership, unprofitable ventures may be carried on indefinitely at the public expense. Deficits come out of the tax levy and fixing responsibility for failure is so difficult that mediocre administration "gets by" in the face of defections that would break a reputation in private industry inside of thirty days.

Einstein's Theory

MUCH attention has been devoted of late in the scientific and technical press to a discussion of Einstein's theory of relativity and its consequences. This subject formed the principal topic of discussion at a meeting in London of the Royal Society, various abstracts concerning which have recently been reported.

The subject of relativity first came into notice some years ago when Michelson and Morley announced the results of a careful series of optical experiments they had made for detecting, if possible, the effect of the earth's tangential motion of rotation in aiding or opposing the transmission of light in the laboratory. The effect of the earth's superficial velocity on the apparent velocity of light in the air could not be detected, although the sensitiveness of the apparatus was amply sufficient for the purpose. In order to account for the absence of the earth's velocity component in the observations, two suggestions were offered, which later crystallized into opposing schools of thought. One was that any bar, rod or prism of substances would be subjected to internal electromagentic stresses when subjected to motion; because, according to the theory of electrons, considered either in a crowd or pair by pair, their mutual attractions are altered by their velocity through the ether. Consequently, a metallic bar set in the direction of the earth's tangential velocity does not have exactly the same length as when it is set perpendicularly

thereto. The difference should be extremely small at the greatest value of the earth's rotational surface velocity, and would be undiscoverable by any known laboratory methods; but it has been asserted to be sufficient to account for the non-success of the Michelson-Morley experiments. The other suggestion was the doctrine of relativity, a principle in virtue of which absolute velocities should be incapable of being detected in a universe constructed like ours.

One shcool of thought thus argued that if the sensitiveness of the Michelson-Morley apparatus were greatly increased, a residual effect of the earth's velocity should be found, in spite of the electronic forces and their effects on the mechanism in masking the phenomenon sought. The other school of thought argued that such a phenomenon could not exist, by reason of the inherent nature of things.

Following up the doctrine of relativity, by a long process of mathematical reasoning Einstein and his followers have been led to enunciate certain remarkable theorems concerning space and time. These theorems are interesting as philosophical speculations. From the standpoint of engineering, they are at present too minute in their effects to have any bearing on practice; although, from the standpoint of philosophy, they are of great importance. More recently, however, certain practical deductions have been stated by the relativists which are quite worthy of examination by astronomers. One is that the perihelion of Mercury's orbit should advance at a small but definitely measurable rate, not yet required by Newtonian principles. A second is that rays of light should bend very slightly in passing through the sun's gravitational field, and third that the red rays of the spectrum should be measurably deflected in such a field. The first two predictions are now stated to have been confirmed reasonably well. The third has not yet been confirmed, although carefully looked for.

The newly awakened interest in the subject has come from the recent confirmation of the second prediction, on the occasion of last May's total solar eclipse. Astronomers appear to be satisfied that such an effect has been discerned. Assuming that both the first and second predictions have been verified, the question arises whether the doctrine of relativity is really fundamental, or whether it is a mere secondary consequence of a yet more fundamental electromagnetic law. We shall probably have to wait for the answer to this question. The mathematical theory is very complicated, and very few persons appear to understand it. Discussion is interfered with, because the doctrine of relativity assumes, in some minds, the nature of a fetish. Nevertheless, if, as is claimed by some, that doctrine denies the existence of a space-filling ether and substitutes an emission theory for the accepted undulatory theory of light, it is worthy of careful examination.

Engineering education deserves the support of industry on many grounds. The highest technical training guarantees a permanent increase in production realized through the acumen of men and women combining theory with practice in ways difficult to those with unbalanced schooling. As the experience of the technical graduate ripens fast under most business régimes an investment in engineering education soon pays for itself and continues thereafter an increasing asset to civilization.

Reorganizing a Distribution System

THE time often comes when, with the growth of a city system of distribution, radical changes become necessary to secure the greatest economy in conductors and the best regulation. Such a crisis has come in the affairs of the Seattle municipal system, and J. D. Ross in the current issue gives an account of the very effective procedure which is being adopted. The present system is supplied partly by a 40-mile (65-km.) transmission line and for the rest by a steam station. The original installation was one of the few plants using two-phase distribution, a condition brought about by an existing two-phase private plant. The lines from the Cedar River hydroelectric plant were duplicate three-phase and star-connected. The new transmission plant is being built on the Skagit River, 100 miles (160 km.) from the city, and the possible final capacity is about 500,000 hp. Over this longer distance it is proposed to transmit at a delivered voltage of 150,000. This transmission is star-delta-connected like the existing one.

An interesting feature of the new hydroelectric station is that the generator, rated at 45,000 kva., is solidly coupled to the transformers through a reactor. All switching will be done on the high-tension side. The voltage control is by an automatic regulator at the station and another acting on the synchronous condensers at the receiving end.

The substations from the new and old plant are half a dozen miles (about 10 km.) apart with the steam plant between them, and at this end of the line begins the new distribution system. The old one is at 2,500 volts, and, because of the rapid growth of the city, it has become burdensome in cost of copper.

The distribution now being installed is at 15,000 volts, star-connected with neutral, giving about 26,000 volts between phase wires. This main distributing network will tie together the two substations and the steam station and will itself feed a working distribution at 2,500 volts, delta-connected for motors, mostly supplied through single-phase feeders for lighting. Seattle being a long and narrow city, the 15,000-volt intermediate distribution is particularly desirable in the matter of regulation. The new arrangement will permit an immense saving in copper and will bring the variations in voltage from no load to full load so low as to be very easily regulated without the present considerable complications in feeder regulators. The new service, too, will be three-phase instead of two-phase, which again saves some copper besides obviating the use for further development of motors which must now be regarded as non-standard, the fact being that two-phase distribution is obsolescent. The 15,000-volt system is of No. 2 wire for mechanical reasons, and this fully meets the requirements of close regulation. It is reckoned that the saving in lost energy by the changes will amount to something like 10 per cent. Ordinarily transmission through an intermediate primary voltage is unnecessary, but as the transmission voltages get higher and higher and the areas served increase the time now and then comes, as it has in this instance, when the wise procedure is to bring the main transmission to one or more substations and then to take advantage of the big step-down transformers with their very high efficiency to feed the intermediate distributing voltage, which can be readily carried over an extent of territory which would be extremely inconvenient to arrange for the high transmission voltage and far too expensive in copper in adhering to the house-to-house primary voltage.

Maximum-Rated Motors

MOTORS, like all other devices made by man, have their limitations—and occasionally break down in service. They may be short-circuited from a failure of internal insulation; their bearings or commutators may become mechanically defective; they may be strained by mechanical overload, or they may be injured by overheating.

Breakdowns in insulation due to purely electrical defects are relatively rare accidents, and the complaints made against motors on this score are comparatively infrequent.

Breakdowns due to purely mechanical defects, such as overloads or weak commutators, are well understood by the average mechanic, who is thus in a position to protect the motor from injury or to repair its defects.

Breakdowns due to thermal overloads are the most troublesome and difficult to deal with, because they are likely to take time to develop. The overheating is apt to be deep-seated and beyond the limit of superficial examination to reveal. The causes are more obscure, are less generally understood and are apt to be cumulative.

The insulating materials in large and expensive dynamo machines are commonly such as can, like mica, stand a relatively high temperature for long periods without injury. On the other hand, the materials that have to be used for insulating the field and armature windings of the smaller dynamo machines, such as constitute the great majority of our industrial motors, are cellulose in one form or another; viz., cotton, paper or fiber. These materials are subject to decomposition and alteration of mechanical and electrical properties, at a temperature near to that of boiling water. If any part or element of the whole winding of a motor reaches the critical temperature, thermolysis there sets in. The damage done depends upon how much the temperature exceeds the critical value and how long it lasts. A sustained temperature, well over the limit, will produce rapid carbonization, with swift loss of mechanical and electrical strength. Moreover, the temperature within the deeper recesses of the windings may be very appreciably hotter than on the exposed external portions. It is essential, therefore, that for long life a motor shall have a temperature at the hottest internal spot less than the critical temperature of chemical decomposition.

In order to make sure that the hottest spot, which is probably deep out of reach, in a motor shall not attain the limiting temperature, the temperature on the accessible surfaces should not be allowed to exceed a certain lower temperature that experience has provisionally assigned and which varies somewhat with the type of motor.

But if the ambient temperature were to rise to 40 deg. C., or if the ventilating ducts in the machine were to become partially clogged in the course of time, or the brushes were to wear badly and set up extra heating, it is evident that the hottest spot would be likely, under the same load, to exceed the decomposition temperature, especially in an old and neglected motor during hot weather. On the other hand, in winter weather, or in a cold climate, or an exposed location, where the ambient temperature never exceeded 20 deg. C., the 50 deg. load and basis of rating might be perfectly safe for the motor.

When motors are carefully installed and are maintained by trained attendants, who understand their business and the thermal inwardness of the motors committed to their charge, risks of overheating may be safely incurred and smaller motors used than in plants where less careful inspection is exercised. In such cases eternal vigilance is the price for a smaller margin in safe temperature.

The article which we print this week on the subject by A. C. Bunker is a plea for the motor of greater thermal factor of safety in the average plant. There is much to be said for his side of the case. There is a prudent mean position to be followed. It is just as possible to exaggerate the dangers pointed out in the article as it is to minimize them. It is as bad economically to install unduly large motors with small temperature rises as to install unduly small motors that may burn out from overheating. Unless, however, skilled men are employed to maintain a motor installation, it is reasonable to have a good margin of thermal safety.

Regulation of utilities must be reasonably restrained if the incentive to build up a prosperous and expanding public service is to be retained. Shylocks do not make for progress in the public utility field.

Teachings of Experience

THE results of a short circuit on a 900-volt, 25-cycle underground transmission line on the system of the Commonwealth Edison Company, Chicago, which are described elsewhere in this issue, have emphasized the value of some of the engineering features of modern central stations. There was nothing unusual about the initial trouble, but it occurred in such close proximity to a generating station that the effect was quite far-reaching. The resultant explosion in the manhole was very severe, but it failed to damage or displace any of the seventeen other cables which were there. These cables were adequately protected by their fireproofing. The older ones were covered with split tile, and the last cables installed were cemented in accordance with present practice.

In the substations and generating stations the advantage of supplying the safety devices with energy from a small storage battery having no other duty was well demonstrated. The value of the protection afforded the system by reserve batteries was also proved in spite of the fact that these batteries were naturally of insufficient capacity to carry the entire load at full pressure for such an extended period. This is an expensive but very desirable form of service insurance.

The value of proper fusing in an Edison three-wire distributing system was amply demonstrated in this accident. When the two direct-current subtations were shut down it was only the fuses in the system that saved large sections of the underground cable from being destroyed by the heavy drafts of current from more distant substations which attempted to supply service to the affected area. Had the downtown district been supplied by a smaller number of larger substations the effect of the disturbance on the underground system would undoubtedly have been more severe. The area covered is less than a square mile and is supplied by nine substations rated at from 3,000 kw. to 9,500 kw. each. While this disturbance on a large generating system brings out no fundamentally new features, it demonstrated that a system of 500,000 kw. capacity or more can be kept under control when, as in this case, the skillful developments of the engineers of the industry are embodied in its design.

Application of Vectors to Wiring Diagrams

Relay and Metering Schemes Are Worked Out by Means of Vector Diagrams—A Systematic Method of Notation and Analysis Is Offered for the Solution of Such Problems

BY LEWIS A. TERVEN
Westinghouse Electric & Manufacturing Company

IT IS doubtful whether vectors are used to better advantage in any other field than in their application to wiring diagrams. Several specific problems are taken up in this article in order to make it possible for the reader to apply the method at will. In the matter

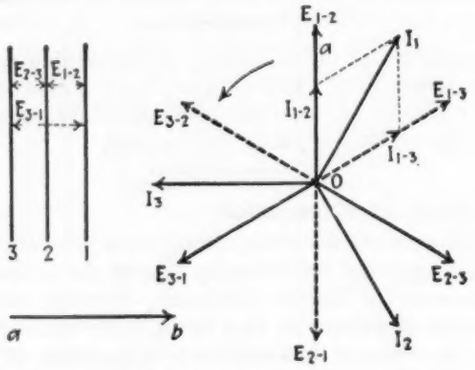


FIG. 1—GENERAL VECTOR RELATIONS IN A THREE-PHASE CIRCUIT

of notation the double subscript scheme appears to be the best available and has been adopted in the present paper.

A vector represents by its length and direction the qualities of intensity and relative phase of the electrical quantity represented.

In the examples of diagrams shown, the vectors are read in the direction of the arrow; thus, in Fig. 1, the vector is called V_{a-b}, where V represents an arbitrary quantity or vector. Reading opposite V_{b-a} would mean $-V_{a-b}$. Counter-clockwise rotation of vectors is assumed, and, unless specifically marked, phases 1, 2 and 3 occur in order reading down on horizontal buses and

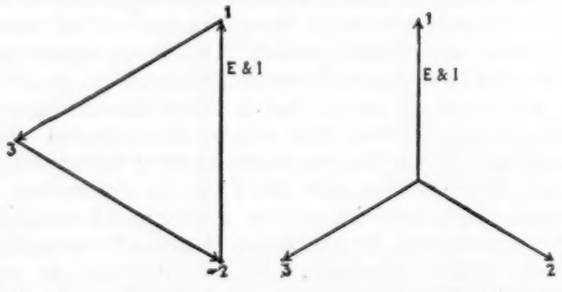


FIG. 2—VECTOR DIAGRAMS FOR INTERNAL RELATIONS IN STAR-CONNECTED AND DELTA-CONNECTED GENERATORS

from right to left on vertical buses. Vectors are assumed as to general length and direction with reference to average values and position and not as due to instantaneous values. In other words, a positive direction of flow of power through the circuit is taken and vectors are drawn to correspond.

Since three-phase distribution of power is the rule, and as any other system can be interpreted from the principles applying to the three-phase system, the latter is selected here for applications. In Fig. 1 *oa* represents the voltage from line 1 to line 2, and may be called E_{1-2}; E_{2-3} lags behind E_{1-2} by 120 deg., and E_{3-1} lags behind E_{2-3} by 120 deg. Voltages E_{2-1}, E_{3-2} and E_{1-3} can be obtained by simply reversing E_{1-2}, E_{2-3} and E_{3-1}, as indicated by dotted lines. The current (I_1) in line 1 consists of a current caused by the voltage E_{1-2} from wire 1 to wire 2, and a current due to potential E_{3-1}, which will flow from wire 3 to wire 1. The current in line 1 due to E_{1-2} may be considered as positive since the sign of the sub I is +, and in order to add to I_{3-1} the latter must be reversed to the position shown dotted I_{1-3}. The vector sum of current in phase with E_{1-2} and E_{1-3} gives I, which represents in value and direction the current in line 1. In a similar way, the currents in lines 2 and 3 are found, and they are indicated in Fig. 1 as I_2 and I_3. The vector relations thus deduced correspond to unity power factor, and with the vectors so drawn it may be said that the current in a wire lags 30 deg.

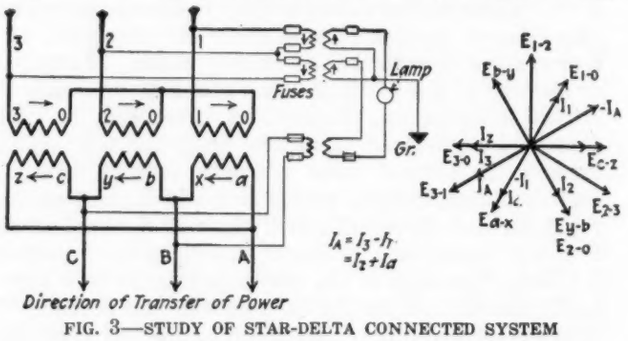


FIG. 3—STUDY OF STAR-DELTA CONNECTED SYSTEM

behind the voltage between that wire and the next wire reading counter-clockwise.

In case of a delta-connected generator the internal-vector diagram of both voltage and current is shown in Fig. 2a; for a three-phase star-connected generator the internal vectors are represented in Fig. 2b. The external conditions in both can be represented by Fig. 1 as before.

As so many different methods of connecting transformers are in practice, vector representation of the current and voltage relations is more complicated than in the case of generators. With delta-delta or star-star-connected transformers the phase relations in the primary will differ by 180 deg. from corresponding relations in the secondary. For delta-star or star-delta transformation, the line current of the primary will be 30 deg. displayed from the line current of the secondary. This condition is shown on Fig. 3. This case is worked out rather fully since it is a representative problem.

The phase relations in the primary are shown by vectors E_{1-2}, E_{2-3} and E_{3-1} for voltage and I_1, I_2 and I_3 for current. The current I_1 is in phase with the voltage E_{1-0} at unity power factor, and I_2 and I_3 can be shown to

agree in phase with E_{x-0} and E_{z-0}, voltages which produce the currents concerned.

Considering the internal relations of each transformer, E_{x-a} must be 180 deg. out from E_{1-0}, due to the fact that one is the induced and the other is the impressed voltage of the transformer. In a similar manner E_{y-b} and E_{z-c} are 180 deg. out of phase with E_{1-0} and E_{3-0} respectively. But it must be borne in mind that the primary of the transformer functions as a motor, while the secondary acts as a generator. Hence voltage E_{x-a} is in phase with E_{1-0} as far as the external circuit is concerned, because if a circuit should be established between wires x and a the current would flow from x to a exactly in phase with the current flowing from 1 to 0 in the primary.

The current in wire A is the vector sum of the currents I_z and I_a. This resultant vector is found as indicated in Fig. 3. and is 30 deg. ahead of the current in wire 3 or I_3, or voltage E_{z-0}.

A simple solution for determining the secondary currents results from neglecting the interposition of each transformer, one by one, because single-phase transformers do not affect the direction of flow of current from primary to secondary. Thus, if current I_z should jump the gap from 3 to z its direction from z to A would

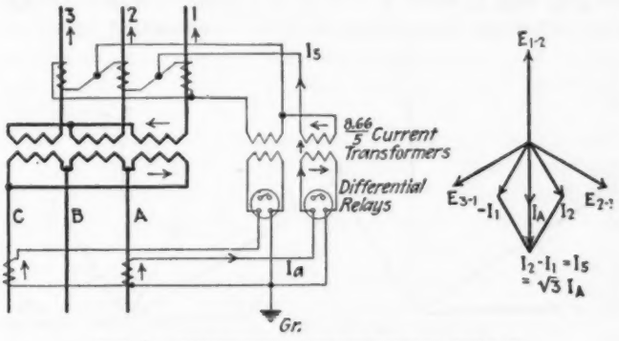


FIG. 4—CONNECTING DIFFERENTIAL RELAYS

be just the same as the direction of the current which results when considering the presence of the transformer. Similarly I_2 would flow from 2 to y and on into wire C. From this method I_a results from $+ I_3 - I_1$, which gives the same position as before.

I_a in this particular arrangement is really 180 + 30, or 210 deg., behind I_1, or $-I_1$ is 30 deg. ahead of $-I_A$. If the primary diagram had been drawn with wires 1, 2 and 3 entering the primary coils on the right of the individual coils, then I_A would equal $I_1 - I_3$ and be located 30 deg. behind I_1.

As long as the neutral of the high-tension star is available and voltage transformers are connected between line wires and the neutral, no difference of phase will result relative to the voltage between line wires in the secondary. Thus E_{1-0} corresponds to E_{x-a}, E_{z-0} to E_{y-b} and E_{3-a} to E_{z-c}. But frequently the potential transformers are connected between 1 and 2 and between 2 and 3, giving E_{1-2} and E_{2-3}. From the vector diagram (Fig. 3) it is seen that E_{1-2} is 30 deg. ahead of E_{1-0} or E_{x-a}. If it is desired to synchronize between the high-tension and low-tension sides of the transformer, as occurs when generators are feeding the low-tension side and the high-tension side is connected to an incoming power system, voltages from the secondaries of the potential transformers must be selected which are in either phase or 180 deg. apart. Again referring to diagram Fig. 3, it is seen that E_{y-b} $(= E_{C-B})$ will correspond to E_{z-0} $(= E_{3-2} - E_{1-2})$ in phase, but since the resultant is 8.66 times the value of E_{1-2}, E_{2-3} or E_{y-b}, potential transformers must be selected of the proper ratio to produce 100 volts in the secondary system of the voltage transformers. (It is usual practice to choose potential transformers with appropriate ratio to give 100 volts, nominal voltage, in the secondary.) All of the above difficulties in synchronizing may be avoided

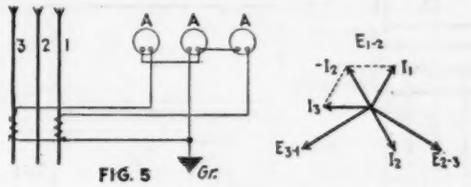


FIG. 5

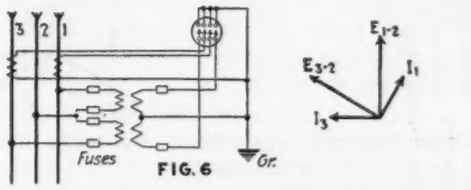


FIG. 6

FIGS. 5 AND 6—CURRENTS DERIVED FROM OPEN-DELTA CONNECTION; COMMON ARRANGEMENT FOR POLYPHASE WATTMETER

by the use of a synchroscope instead of lamps, in which case the pointer of the synchroscope is shifted to the zero position when primary and secondary are in synchronism. Afterward the instrument will always indicate synchronism at the correct location of the pointer of the meter.

A similar problem arises when it is desired to protect the power transformers shown in Fig. 3 through the use of differential relays. Fig. 4 shows such a scheme and the vectors illustrating the application. From the vector diagram it is seen that the current in line A and hence in secondary of current transformer in line A is that arising from vector summation of $-I_1 + I_3$. In order to obtain a current from the primary side of the power transformer which will be in phase with I_A or I_a, it is necessary to compound $I_3 - I_1$. Hence the current transformers in the primary are connected delta, and current I_5 represents $I_1 - I_3$ and corresponds to I_a in connection

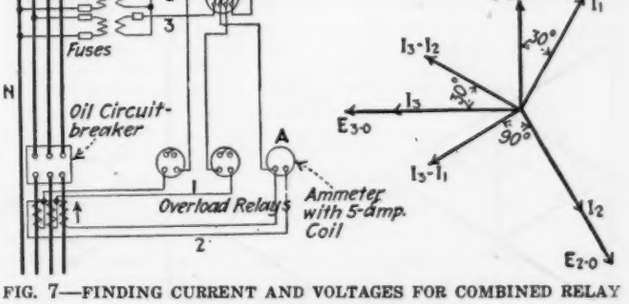


FIG. 7—FINDING CURRENT AND VOLTAGES FOR COMBINED RELAY AND WATTMETER SCHEME

with the differential relay. This means that the current I_a would flow through the current transformers on lines 1, 2 and 3 in preference to taking the path through the relay, since the instrument possesses a high reactance. In a similar way, current I_5 flows through the current transformer on wire A. Expressed differently, current I_a is a continuation of current I_5, and so long as they are of equal magnitude no current will flow through

the differential relay. It usually happens that the current transformers are manufactured for a 5-amp. secondary rating, and as I_3 would correspond to $\sqrt{3} \times 5$, or 8.66 amp., a current transformer with a ratio of 8.66 to 5 would have to be used between the relays and the current transformers in the primary wires. Special current transformers can be installed on wires *A* and

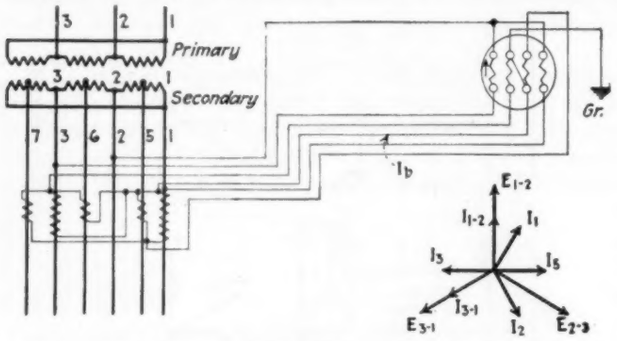


FIG. 8—THIS CIRCUIT OFFERS SEVERAL SOLUTIONS IN POWER MEASUREMENT

C, which will give a normal secondary current of 8.66 amp., thus avoiding the extra 8.66/5-amp. current transformers; but it frequently happens that the special current transformers do not lend themselves to use with meters, and the latter are frequently installed on the same set of current transformers.

SOLVING METER-CONNECTION PROBLEMS

The widest application of vectors to diagram work comes in the selection of the proper phase conditions to indicate the correct values of electrical quantities of a circuit. Problems involving combinations of voltage and current are numerous, and a few illustrations follow.

One of the most simple vector combinations permits the use of only two current transformers to measure the current in any leg of a three-phase system. This is shown in Fig. 5. Note that $I_1 + I_3 = -I_2$, or $-I_1 - I_3 = +I_2$.

The expression for power in a three-phase circuit is $\sqrt{3}EI \cos\phi = 1.73\ EI \cos\phi$. A commonly used vector combination to measure three-phase power is shown in Fig. 6. Two potential and two current transformers are connected to a polyphase wattmeter, the latter consist-

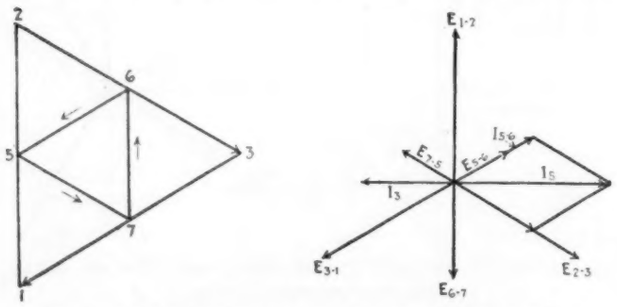


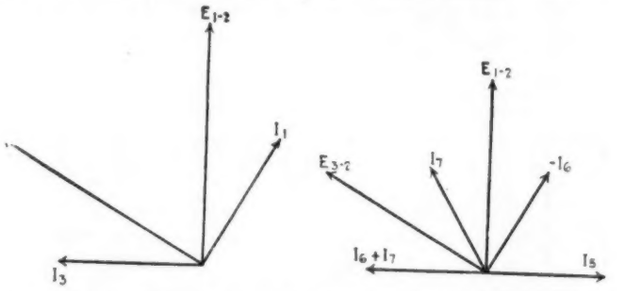
FIG. 9—SIMPLIFICATION OF RELATIONS SHOWN IN FIG. 8

ing essentially of two independent parts, a right half and a left half. In each part a current is multiplied by a voltage and the wattmeter reads the sum of the power indicated by the two halves.

The power indicated in Fig. 6, eliminating power factor, is $(I_1 \times E_{1-2} \times \cos 30 \text{ deg.}) + (I_2 \times E_{3-2} \times \cos 30 \text{ deg.}) = 0.866\ IE + 0.866\ IE = 1.73\ EI$, the condition to be met for measuring power in a three-phase circuit.

The current and potential transformers used for power indications may be used for other instruments, meters, or even for relays. Under such limitations considerable ingenuity must be exercised to obtain proper vectorial relations in the different apparatus. In Fig 7 a portion of a wiring diagram and the vector relations existing at the wattmeter are shown.

As the currents in the lines are in phase with their respective voltages to the neutral, no 30-deg. relation between current and voltage can be obtained without compounding. This may be done as in this typical case, the right side of the meter using E_{1-0} and $I_1 - I_2$, and the left side using E_{3-0} and $I_3 - I_2$ [$= -(I_2 - I_3)$], because it is not possible to use $-I_2$ twice and it has already been used once on the right-hand side of the meter. (The reverse of I_2 to $-I_2$ is accomplished by entering the meter from the top or reverse direction as shown.) The unused vectors will then be $I_3 - I_1$ and E_{2-0}, and since they are 90 deg. out of phase, no power will be derived from them, but the first four vectors named will correctly indicate the power in the three-phase, four-wire circuit. The currents $I_1 - I_2$ and $I_2 - I_2$ represent the vector summations of I_1 and I_2 reversed, and I_3 with I_2 reversed. Hence these currents are 1.73 times the value of I_1, I_2 or I_3, assuming balanced



FIGS. 10 AND 11 — VECTOR RELATIONS FOR MEASUREMENT OF POWER AT 220 VOLTS (10) AND 110 VOLTS (11); CONNECTIONS AS IN FIG. 8

currents flowing in the circuit. This condition must be taken care of by calibration of the meter.

Only two relays are shown, but good protection of the circuit is afforded because the current in one relay is due to I_1 and I_2 and that in the other is due to I_3 and I_2. A third relay could be inserted in the third leg of the delta between the ammeter and the wattmeter. The ammeter is connected with only one current transformer in order to use a 5-amp. full-scale instrument.

AN UNUSUAL CONDITION

In Fig. 8 a rather odd condition for power measurement is represented. From the secondary of a three-phase delta-connected power transformer wires 1 to 7 are run, and of these lines Nos. 1, 2 and 3 compose a three-phase, 220-volt circuit, while Nos. 5, 6 and 7 form the neutrals to the three-wire systems 1-5-2, 2-6-3 and 3-7-1. It is desired to connect a single polyphase wattmeter which will indicate the power under all conditions of power consumption, whether the lines be balanced or not. As the voltage coils of the wattmeter must be connected to one or the other values of voltage, the current transformers in the 110-volt lines must be of one-half the ratio of those in the 220-volt lines. Potential coils of 220 volts are chosen with standard 5-amp. current transformers in the 220-volt wires, which will

correspond to 2.5-amp. current transformer secondaries in the 110-volt lines.

To solve the problem connections are first made for 220-volt, three-phase power; then connections are added for 110-volt, three-phase power; afterward checks are taken for three-wire load, balanced or unbalanced. Vector relations between the current in the 220-volt delta and the 110-volt neutrals must first be deduced. This may be done in several ways, one of which is shown in Fig. 8, where the current in the neutral wire I_s is considered as being due to the currents which return on I_1 and I_2. This brings I_5 in phase with $-I_2$, I_6 in phase with $-I_1$, and I_7 in phase with $-I_3$. Another view of I_5 results from considering it as the outgoing current from a corner of an imaginary 110-volt delta, as shown in Fig. 9. Here E_{5-6}, E_{6-7} and E_{7-5} are shown in correct rotation to close open V connections 5-2-6, 6-3-7 and 7-1-5 respectively. I_5 is the resultant of I_{5-7} in phase with E_{5-7} and $-I_{6-5}$ in phase with $-E_{6-5}$. As before, I_5 comes out as $-I_3$ in phase.

The vector relations obtaining in the 220-volt power measurement are given in Fig. 10. Although current I_b, consisting of $I_1 - I_3$, arrives at the wattmeter terminals, only current I_1 goes through the wattmeter coil since the other end of the coil is connected to $-I_1$, and a bridge connection is provided between the bottom of the right-hand meter-current coil and the top of the left-hand meter-current coil, which conducts $-I_3$ to the top of the left-hand coil, which is the place where it should go.

For 110-volt, three-phase power two current transformers would be sufficient, one being in line 7 and one in line 6. The right-hand side of the meter would be fed by $-I_6$ and the left-hand side by $I_7 + I_6$, $-I_6$ being in phase with I_1 and $I_7 + I_6$ with I_3. However, three current transformers are essential, because otherwise power could be drawn from line 2 to line 5 without any power indication in the meter. Fig. 11 shows the vectors as selected, $I_7 + I_6$ being used in phase with I_3 and $I_5 + I_7 = -I_6$ being used in phase with I_1.

Checking Meter Accuracy

A check on the accuracy of the meter for different conditions may be had by assuming all possible current combinations one by one. For three-wire power 1-5-2, if balanced, all power will be shown by the right-hand side of the meter as $E_{1-2} \times I_1$. If unbalanced, the current in I_3, being then in phase with I_1, will add or subtract arithmetically from I_1 according to whether the greater load be from line 1 to 5 or from line 5 to 2.

THE CHARACTERISTICS OF ELECTRIC STEEL CASTINGS

Steel of Any Given Chemical Composition Produced in Electric Furnace Will Be Better than That Produced by Other Methods

Physical characteristics of electric steel castings show that much better results can be obtained by the electric process than by the use of any other method. The heat can be controlled so accurately that almost any desired chemical composition can be obtained. This fact is shown by the accompanying analysis and physical characteristics of both acid and basic steel of one manufacturer. Furthermore, such results were consistently obtained in every heat of electric steel. Low phosphorus and sulphur with a high ratio of elastic limit to ultimate strength has been obtained by another manufacturer of electric steel, the results in detail being shown in Table II.

The actual comparisons of open-hearth and electric steel castings which follow show very clearly the value of the latter:

COMPARISON OF OPEN-HEARTH AND ELECTRIC STEEL CASTINGS

	Open-Hearth	Electric
Elastic limit (lb. per sq. in.)	35,000	45,000
Ultimate strength (lb. per sq. in.)	70,000	80,000
Elongation (per cent)	15	30
Reduction in area (per cent)	50	45

This steel is of the following composition: C, 0.25; Si, 0.20; Mn, 0.55; S, 0.01; P, 0.01. It is used for marine construction such as propeller shafts. The electric steel is tough and very resistive to vibrating and alternating shocks and stresses.

Results of comparative tests of electric and open-hearth steel for forged armature shafts and electric railway axles are given in Table IV. The castings were heated to 1450-1460 deg. Fahr. (790 deg. C.), held at that temperature for one hour, quenched in 65 deg. oil, and then drawn at 1185-1200 deg. Fahr. (645 deg. C.) for one hour and cooled slowly in the furnace. The open-hearth steel was also heat-treated after it had been forged.

Excellent results were obtained by electric steel makers in munition work. In Table II are shown the characteristics of low-nickel-chrome gun-steel forgings for the navy. After forging they were quenched at 1400 deg. Fahr. (875 deg. C.) and drawn back at 1200 deg. Fahr. (650 deg. C.).

The figures reproduced in this article were collected by the Electric Furnace Association in an endeavor to assemble accurate data.

TABLES I TO III—CHEMICAL COMPOSITION AND PHYSICAL CHARACTERISTICS OF ELECTRIC STEEL CASTINGS

		Analysis					Physical			
		C.	Si	S	P	Mn	Tensile Strength, Lbs. per Sq. In.	Elastic Limit, Lb. per Sq. In.	Reduction in Area, per Cent	Elongation in 2 In., per Cent.
Table 1	Basic....	0.19	0.23	0.025	0.044	0.74	66,750	42,500	51.7	35.0
	Basic....	0.23	0.20	0.021	0.040	0.64	76,000	45,000	45.8	30.0
	Acid....	0.19	0.27	0.043	0.036	0.52	62,400	36,500	50.0	32.0
	Acid....	0.24	0.33	0.050	0.056	0.70	69,000	37,800	44.0	28.0
Table 2		0.80	0.40	0.027	0.020	0.62	113,250	62,250	20.2	15.0
		0.40	0.50	0.020	0.011	0.52	97,300	49,230	29.4	20.5
		0.23	0.35	0.024	0.018	0.55	70,000	27,500	52.0	33.5
		0.18	0.40	0.022	0.016	0.70	62,500	39,000	55.5	34.2
		Cr.	Ni.							
Table 3		0.34	2.25	0.35	0.11	0.023	0.029	0.56	102,000	65,000	52.5	31.0
		0.40	3.40	0.35	0.19	0.025	0.010	0.57	105,850	74,000	54.1	22.5
		0.45	2.91	0.39	0.11	0.026	0.023	0.54	102,125	60,000	51.8	22.0

TABLE IV—COMPARISON OF PHYSICAL CHARACTERISTICS OF STEEL MADE BY OPEN-HEARTH AND ELECTRIC FURNACE PROCESSES

	Armatures		Axles	
Properties	Open-Hearth	Electric	Basic Open Hearth	Basic Electric
Ultimate strength, lb. per sq.in..	91,200	107,700	89,100	105,140
Elastic limit, lb. per sq.in.....	46,000	69,950	41,060	61,850
Elongation (per cent).....	22.2	23.5	21.5	22.0
Reduction of area (per cent)....	44.8	50.0	31.74	52.37
Elastic torsion, lb. per sq.in.....	16,750	33,700	16,750	33,700
Shearing strength, lb. per sq.in..	62,400	76,000	.....	.....

New Distribution System for City of Seattle

On Account of Scattered Loads, Feeders from Substations Will Operate at 15,000 Volts to Neutral—This Requires Only Small Conductors, Gives Excellent Voltage Regulation and Small Energy Loss on the Lines

BY J. D. ROSS
Superintendent of Lighting, Seattle, Wash.

BY THE adoption of a system of feeders from substation to distribution centers, operating at 15,000 volts to neutral (25,980 volts between phases) the city of Seattle expects to dispense with feeder regulators and to replace many miles of 350,000-circ.mil cables by No. 2 wires, saving over 50 per cent of the 2500-volt copper now in use. The No. 2 wire is adopted to insure mechanical strength, and about 10 per cent of the energy now delivered to the distribution system will be saved by an enormous reduction in line losses.

Seattle owns its own light and power system and is also served by a private company under Stone & Webster control. The city plants serve 60,000 customers besides city institutions and street lighting, and the company serves 30,000 within the city limits. Seattle since the war is generally credited with more than 400,000 people. The company, being first in the field, has established its service in the business section, leaving the outlying districts for competition with the city. At the time the city entered the field in 1904, the company operated a two-phase system and the city followed suit in order that power apparatus might be used on either system.

GENERATING SYSTEM

The city distribution system is supplied partly by its Cedar River hydroelectric plant, 40 miles (64 km.) distant, through two three-phase, 60,000-volt, star-connected lines. This plant, with additions now under way, will be equipped to generate 20,000 kw. A steam plant in the city now furnishes 20,000 kw., and another unit is being added, making a total of 35,000 kw. in steam power.

A new hydroelectric plant of 36,000 kw. as a first unit on the Skagit River has been financed and work is under way. This site is 100 miles (160 km.) from Seattle and will admit of the installation of 500,000 hp. On this account transmission will be at 160,000 volts or higher, delivering 150,000 volts at Seattle. Since during the fifteen years of its life the Seattle system has not lost a single main-station transformer, and since the insulation of to-day is still more dependable, and since very large low-voltage switches and busbars give more trouble than they prevent, the 45,000-kva. generators will be coupled solidly to the transformers through a reactor and all switching will be done on the high-tension side. The station will then become simplicity simplified, reliability will be greater, and the work and troubles of operation will be reduced. The system will be controlled by the proper "T.A." regulator acting on the station voltage and by another acting on synchronous condensers in Seattle to control the power factor.

The Skagit substation will be in the north end of the city, while the Cedar River substation is in the south end about 6½ miles (10.4 km.) distant. Between the two lies the steam plant. All will be interconnected by an intermediate voltage of 15,000 star-connected. The regulation will therefore be well attended to and a uniform voltage supplied at the steam plant and both substations, the condition requisite for good regulation on the distribution system which they supply.

DISTRIBUTION PROBLEM A DIFFICULT ONE

On account of the fact that two competing distribution systems are maintained over a city 20 miles (32 km.) long and about 2½ miles (4.0 km.) wide, every effort must be made to decrease the expense of distributing energy. The city serves all residence customers at the same rate, 5½ cents for the first 45 kw.-hr. and 2 cents for all in excess of this amount. If energy is supplied to the substation busbar at a cost of ½ cent, it is evident that the only opportunity for appreciably cutting the cost to the consumer lies in reducing distribution expense.

Although the two-phase system has no superior from an operating standpoint, the city is changing its distribution system to three-phase. There is a saving of one wire in each power circuit and two-phase machinery is becoming increasingly hard to obtain. Standardization and price tend to make two-phase systems obsolete and Seattle must now make the change.

The choice of an intermediate voltage through the city is the foundation for the radical change in Seattle's system. The very best voltage is the highest that can be used economically, provided that it is as safe to life and property and as easily operated. The writer installed a 15,000-volt, two-phase system in Seattle ten years ago. The center of each phase was grounded and a fifth wire was used as a ground. Customers were served along the waterfront and in suburbs with 7500-volt pole transformers, while 15,000-volt transformers were put under cover, as they were not then made for outdoor work. Substations were connected by the same system. The system worked splendidly, and 15,000 kw. is now so distributed. Service was vastly cheaper. For safety to life and property no wire smaller than No. 2 was used, so the drop in voltage was small, and better results in regulation were often obtained than on the regular 2500-volt feeders with induction regulators. The system was extended to the suburbs. In one case a small suburb, South Park, 7 miles (11 km.) from the substation was supplied from a 50-kw. transformer with good regulation. For years only one No. 2 wire was used to connect this suburb, the other transformer terminal being grounded.

A good-sized steel mill on tidewater was connected two-phase over two wires, the common return being a ground in the salt water. The service was much better than that on expensive 2500-volt feeders, and losses

were less. It is natural, then, that the city should go a step further and change all feeders to this system, abolishing the 2500-volt feeders. It is also a natural step now to choose a three-phase star-connected system with 15,000 volts from phase wire to neutral. Considering the first essential, safety to life, the neutral will be grounded at many points so that there can be no greater voltage to earth than 15,000, as in a 15,000-volt delta system. The lines will be placed on the top of the pole and will always be cut out before work is done on them. They are therefore as safe as any 15,000-volt system delta-connected and safer to linemen than any 2500-volt system which is frequently repaired with the line alive.

A second requisite, best regulation, is met in a manner almost ideal; for while the voltage in relation to all other wires is 15,000, the transmission voltage is 25,980. The same copper will therefore transmit three times as much as on 15,000 volts, or 108 times as much as can be carried at 2500 volts on ordinary feeders using induction regulators. Since, to insure mechanical strength, no wire smaller than No. 2 will be used, it is obvious that there will be almost negligible loss on suburban circuits. In the case of No. 2 feeders, the same mechanical strength, if desired, may be had at a less cost by substituting a steel-cored aluminum cable, the equivalent of a No. 3 copper line. This is ample in most residence work.

Another requirement, low cost, is met in a way that needs no comment. All suburban feeders, branches and secondaries will be of No. 2 wire or smaller. Lowest maintenance and simplicity of operation are also taken care of better than under the existing system.

Finally, concerning power losses, there is no doubt that about 10 per cent of all power now distributed at 2500 volts in Seattle will be saved. Not only is there this great saving in energy but there is a very great saving in copper and automatic regulators.

Thomas insulators rated at 35,000 volts are being used for the three phases in three colors, mahogany, yellow and blue, while the neutral, where carried, will be on a 15,000-volt insulator such as is used at present, though theoretically it does not require insulation.

Fewer Substations and No Voltage Regulators

No transformer either feeding or being fed from this voltage will be star-connected on the other side, so that there is no objectionable star-to-star connection in the entire system. The 15,000-volt star system will now replace the customary 2200-volt or 2500-volt feeders and most of the distribution network of large circuits. The automatic induction regulators will become unnecessary in probably every case. The customary suburban substations will also be rendered unnecessary. Instead of a few large centers of distribution from expensive substations we have many small centers containing only transformers with disconnecting switches or fuse switches. Often these centers are on poles much like the pole transformers on a 2500-volt network. The heavy feeder equipped with its induction regulator now gives place to a high-voltage feeder with practically no loss to compensate for and therefore no need for a regulator. For best regulation the 2500-volt feeder is usually run to a center from which branch lines radiate, some of them doubling back toward the power house; but this is not so in the case of the high-voltage feeder, which may be tapped all along its route, and all centers tapped will have no appreciable difference in regulation. Again, this fact now makes it possible to use small networks around each center so that it is not necessary for residence purposes to have long branches. For this reason no 2500-volt primary and no secondary need be larger than No. 2, while it is doubtful if any larger than No. 4 will be needed. No copper larger than No. 2 is needed for the feeders, so that in all the city distribution there will be no larger copper than this needed except for local power secondaries and tie lines across the city between main step-down stations. About $100,000 in copper and induction regulators will be salvaged from the present distribution system, and all future distribution will be vastly cheaper and simpler; average regulation will be better, operation will be simpler, the main substation will be simpler, and life and property will be as safe or safer. No higher voltage will be introduced in the city than is now used as far as the public property and other property are concerned.

A fair estimate of the voltage regulation over the new system at full load will be as follows:

	Per Cent
Main transformer, 25,980 volts or 15,000 volts; 2500 volts at each distributing center	2.00
2500-vole network	1.50
2500, 250 and 125-volt transformers	2.00
Secondaries and services	1.50
Total drop, no load to full load, beyond residence distributing centers	6.82

This average over all suburban work will not be disturbed by any large suburban power loads as these will be fed directly from the high-voltage feeder without appreciable effect. The voltage regulation of the entire system will depend on the automatic regulators at the hydroelectric and steam stations to regulate voltage and the regulators used on synchronous condensers at the substations to control power factor. Since the drop in feeders from the substations to distribution centers is almost negligible, it is easy to produce the uniform voltage desired at all distribution centers and to have practically perfect control at these points. From these points to the customers' lamps, as stated above, we must meet a voltage drop of 6.82 per cent, and this is the only drop that cannot be easily and completely compensated. An analysis of loads on existing feeders shows that residence loads of different districts do not vary so widely as might be supposed, although in the Seattle circuits, as in most cities, energy for small power demands and business lighting is carried on the same wires as that for residence lighting and cooking. Since the peaks occur about the same time, a great part of the 6.82 per cent drop can be compensated for by regulating the system voltage. This is further made much easier by the fact that the power factor on residence circuits drops to 50 per cent on light load and rises to nearly 100 per cent on full load.

Nature of Distributing Centers

A distributing center ordinarily becomes nothing more than a transformer on one or more poles. The transformer may operate between phases at 25,980 volts or from phase to neutral at 15,000 volts as desired. Stations of each kind will no doubt be used. In general, such a station will be put on a small residence lot bought for the purpose, instead of on the street. Where the district warrants the change a small room may be built to house the transformer. The architecture of this cell may be made as good as or better than the surroundings,

and the small grounds may be made to add to its appearance. The location sought would be the center of load.

Distributing centers may be laid out having one square mile or less in the better districts, and they may be greater in scattered sections. As a rule the smaller the area the better the regulation, the smaller the copper used and the smaller the area and the fewer the people in darkness during any local accident of short circuit. The largest 2500-volt wires and secondaries will be No. 4 and No. 6, with possibly an occasional No. 2. The 2500-volt branches may be connected at the distribution center through disconnecting switches, or if desired they may be connected through fuses and the various branches may be kept separate and not tied into a network as the shortness of the lines eliminates much of the necessity for and advantages of a network. Such a system of separate mains connected through fused switches has the effect of localizing trouble to a degree several times that reached with the usual system. On a test conducted on a branch of a circuit serving 871 customers there were thirty-five transformers with a total rating of 275 kw. The maximum demand of the year was 232 kw. The branch carried 804 residences and apartments, fifty-four small business lighting meters and nine small power loads, besides eight water heaters and twelve domestic-service installations in the residences. The yearly load factor was 25.3 per cent. The street frontage of lots in this district aggregated 70,700 ft. (21,210 m.), and the average frontage per lot was 81.4 ft. (24 m.). The average watts per foot was 3.3. The ratio of secondary bus to street frontage was 61 per cent, making the average watts demand per foot of secondary mains 5.4 watts. The percentage of the district built up was 67.5, so that if fully built up the load to be expected would be 4.9 watts per front foot.

This district is an average one, but, of course, every other district will vary from it and will vary from year to year. The demand will never be less. In this test residence lighting was found to be little more than half the total energy. The day is therefore gone when greater economy in lighting can lessen demand, since small power and electric cooking are increasing and will form the bulk of a greatly increased suburban load.

It will be noted that phase relation is chosen throughout to give best regulation as well as lowest price. The Skagit system will have its step-up transformers star-connected, 160,000 volts, at the power house. At the substation, however, the step-down transformers will be connected in delta, this being thought preferable when the secondary or intermediate voltage is star-connected; *i.e.*, 15,000 volts between phase and neutral. This star system is used alike for interconnecting stations and for feeders. The Cedar River system is also star-connected, 60,000 volts, at the station feeding substation transformers, delta-connected on the high side.

The star-connected feeder system steps down at the distributing centers to short mains at 2500 volts. Where these are three-phase for power purposes the 2500-volt side will be delta-connected. A star 2500-volt system could have no advantages in cost as the runs are short and mostly single-phase. The secondaries are supplied by the regular 2500/250-volt and 125-volt transformers.

SUPPLYING DOMESTIC SERVICE

The low rates given by the city have produced a wonderful effect and the success of electric cooking is now largely a matter of education. This being so, the question of distribution at first seems appalling when we consider the feeder wires required, but the system just outlined meets the difficulty. The only wires requiring a considerable increase in size are the short 2500-volt mains and secondaries. Here, too, we have a choice between larger mains and closer spacing of transformers or subdivision of the network. At present no transformers are spaced further apart than five spans. The low power loss and close regulation to distribution centers and the fact that for mechanical reasons no feeders smaller than No. 2 are used makes domestic service a very desirable load and one not to be feared.

SAVING IN RESIDENCE CURRENT

Besides the saving in copper there is a much more important saving in energy. The Seattle system employs large-sized wire but for years its losses in kilowatt-hours from substation to meters ran between a minimum of 20.6 per cent and a maximum of 22.2 per cent, and this in spite of the fact that 15,000 kw. is distributed on 15,000-volt feeders. The average cost in 1918 of residence energy at the meter was 4.45771 cents, while the selling price averaged 5.20194 cents.

A considerable saving in copper and a 10 per cent saving in energy will combine to make a great reduction in cost. All energy so saved is reclaimed after all fixed charges and operating costs have been paid, and it may be considered as carrying only the costs of extra services and meters with part of its pro rata on the 2500-volt system and secondaries.

Without going into detail, aside from the interest and depreciation on these costs, each kilowatt-hour so saved, at the 1918 selling price of 5.2 cents and at an annual load factor of 25.3 per cent, would be worth $115.24 per kilowatt-year net. The profit on each kilowatt-year sold would be $16.48, so that, aside from the saving in copper and regulators, if 10 per cent of the distributed energy is reclaimed the profit per kilowatt sold at the customer's meter will jump to $29.28.

A 15,000-volt star system gives 25,980 volts between phases. It is the general opinion of cable manufacturers that about 25,000 volts on duplex or triplex cables is the highest limit to which we can with safety go. The writer believes that the future will bring a greater preference for single cables in separate sheaths, and in this case such cables would be insulated for only 15,000 volts. The same is true for submarine cables. In residence districts there is no danger of overloading feeders. Duplicate feeders or sections in important districts are less expensive as cables are small.

SUMMARY

In the new system there will be no feeder regulators. Those now in use will be removed.

The 350,000-circ.mil. 2500-volt feeders, consisting of thousands of pounds of copper, will be taken down. Instead the new feeders will be all of No. 2 copper on the top position of the pole. No. 2 is chosen for mechanical strength.

There will be fewer feeders, so that much space will be saved both in the main substations and on distribution poles.

The residence feeders will supply transformers giving 2500 volts for distributing, except where power jobs are supplied directly along the line at lower voltages. The network will be of No. 4 or No. 6 2500-volt wires, feeding the ordinary pole or underground transformers

supplying secondary mains of No. 4 and No. 6 wires and supplying service at 250 volts and 125 volts.

A loop system between substations, or a system of cross-connections between feeders, may be used at least on important feeders, and sectionalizing switches can be used to cut any section dead for repair without stopping service. The 2500-volt network of the different centers will not be connected but will be entirely separate to minimize the area affected by a short circuit or an open circuit. Life and property are safeguarded as well as or better than before. There will be a flat voltage throughout the length and breadth of the city at every center, no matter how remote. As a final result average regulation will be vastly better. Simplicity of construction will guarantee greater continuity of service.

Saving in material will be very great. Besides the saving in feeder wire, many of the heavier feeder branches will be removed. In Seattle this will save over 50 per cent of the 2500-volt copper now in use. It will also save the cost of regulators and reduce the size of main substations. There will be a great saving of energy—in fact, 10 per cent of all distributed, the cost of which has been paid by the other 90 per cent. There is no danger of overloading a feeder of No. 2 wire, so that electric cooking and suburban power business, large or small, may be taken in remote suburbs as willingly as if close in and will become a good paying load.

The system lends itself readily to underground work for either power or residence service.

The main argument for the system is that for ten years in Seattle it has demonstrated its great worth from all points of view, and at the present time several thousand kilowatts are being rapidly transferred from the 2500-volt system. The writer is now surprised that he and his associates were too conservative to see the importance of this system before.

The writer is indebted to his engineer of inside construction, W. J. McKeen, and his engineer of outside construction, Glen Smith, for their ideas and help in the design of this system.

Electric Heat Treating of Forgings

Operating Results from 900-Kw. Two-Unit Automatic Pusher-Type Electric Hardening and Drawing Furnace—Practically All "Rejects" Eliminated Except Those Due to Variations in the Metals

ELECTRIC heat-treating furnaces are in growing demand where quantity production of a uniform quality is required. One of these furnaces was installed by the Ingalls-Shepard Forging Company, Harvey, Ill., and was used during the war to treat forged aëroplane and tractor cranks which were being manufactured for the government. However, the advantageous use of electric heat treating is not limited to war work. The foolproof qualities of the apparatus make the electric furnace a potent factor in maintaining the quality of the forgings during peace times especially when labor is scarce and inefficient. With the electric furnace a much higher percentage pass the Brinell test than is the case when the pieces are treated in fuel-fired furnaces, and it is the commercial inequality of the steel rather than any fault of the furnace that is responsible for a great majority of the "rejects" that still have to be sent back.

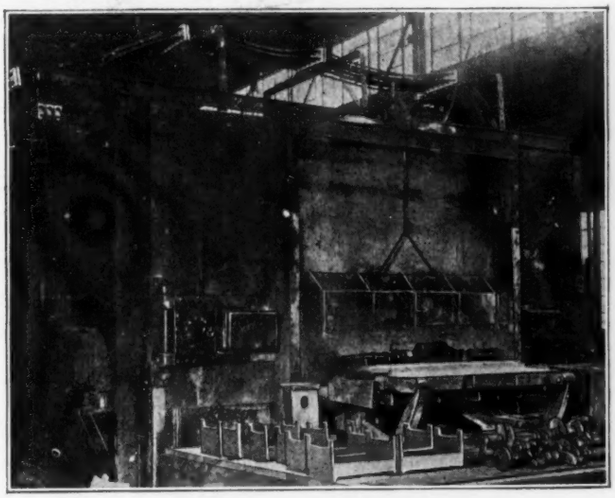


FIG. 1—HEATING SECTION OF FURNACE
This shows the receiving end, the crankshafts to be heat-treated, the supports for the furnace leads and the electrical connections to the side of the furnace.

The furnace being discussed is a Bailey stationary resistance reverberatory type of electric furnace manufactured by the Electric Furnace Company, Alliance, Ohio, and designed to treat 72 tons every twenty-four hours. The unit is built in two similar sections, each containing a hearth 20 ft. by 7 ft. (6 m. by 2 m.). The pieces to be heat-treated are first placed in the heating section, which is heated to a temperature of about 1450 to 1550 deg. Fahr. (790 to 840 deg. C.). Then the pieces, which happen to be cranks in this case, are quenched in water and passed into the second section, where the temper is drawn with a temperature of about 1050 deg. Fahr. (565 deg. C.). The cranks are placed in front of the door of the furnace by hand, but all the

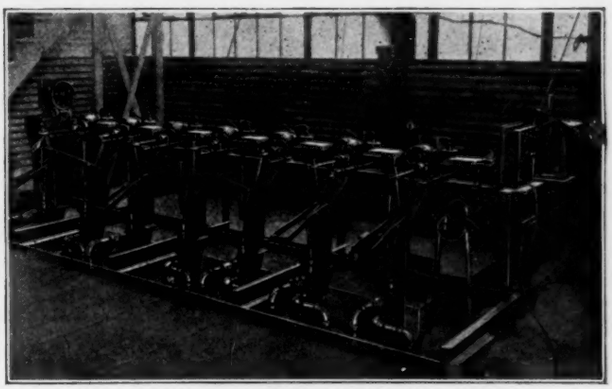


FIG. 2—DRAWING SECTION OF FURNACE
This shows the discharging end, the motor-operated hydraulic control equipment and the motor-driven plunger and centrifugal pumps.

mechanical operations in connection with feeding the pieces through the furnace are carried on continuously by the aid of motor-driven auxiliaries. The heat to the furnace is controlled by manually operated oil switches which connect the heating elements of the furnace sections to different taps on the transformer windings.

Energy is supplied to the furnace from three 300-kva. single-phase transformers. One transformer is connected to each of the two heating troughs in the heating section of the furnace. The two heating troughs in the drawing section of the furnace are connected in parallel to the other transformer. This method of connection balances the load on the three phases, as may be seen diagrammatically in Fig. 4. The same illustration also shows the connections to the transformer tap. The connections between the transformer taps and the oil switches are at the top of the transformer room.

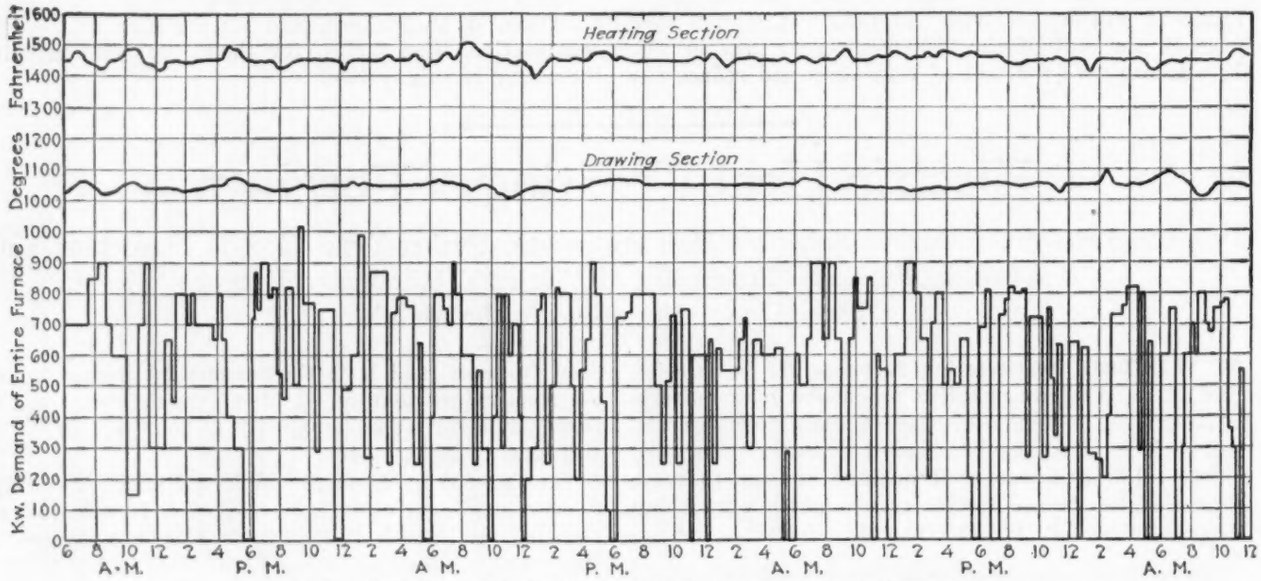


FIG. 3—LOAD AND TEMPERATURE CURVES FOR THREE AND A QUARTER DAYS

No regular records have been kept of the energy consumption nor of the tonnage output of the furnace, but tests were made for three or four days and the curves obtained then are shown in Fig. 3. During that time about 215 kw.-hr. was consumed per ton of metal treated. However, nearly half of the metal was in the cradles which supported the cranks. Consequently the energy consumption was about 400 kw.-hr. per ton of net output. The load factor for the three and one-quarter days averages 54 per cent with a maximum demand of about 1015 kw.

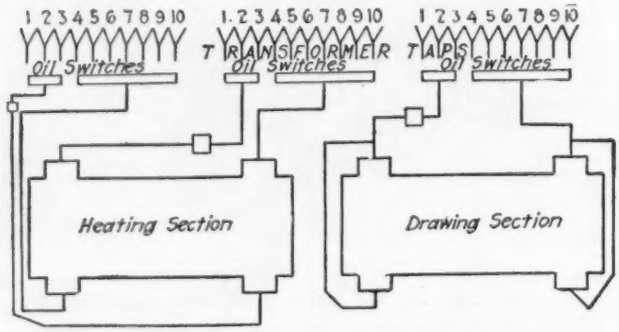


FIG. 4—METHOD OF BALANCING THE TWO SECTIONS OF FURNACE ON THREE SINGLE-PHASE TRANSFORMERS

BURNING LOW-GRADE COALS OF MONTANA AND WYOMING

Tests on Fuels That Have Heretofore Given Operating Men Much Difficulty Show that Proper Furnace Design Will Solve Problem

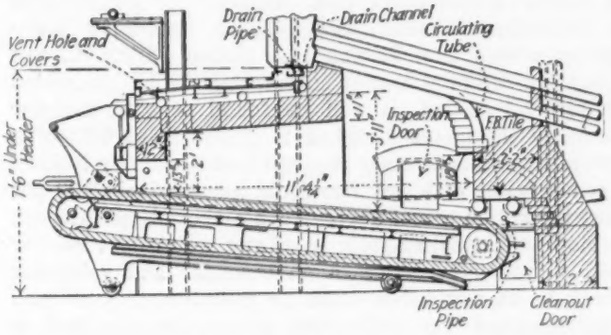
BY E. H. BULL, EAST CHICAGO, IND.

EVER since the commercial development of coal mining in the Red Lodge district of Montana and the Sheridan district of Wyoming thirty-five years ago there have been constant attempts to burn the fuels, but the best results obtained fell far short both from an efficiency and a capacity standpoint. On the average 60 per cent over-all efficiency and 140 per cent of builder's rating were obtained for periods of over two hours' duration. Nearly all the early attempts to burn this grade of fuel failed because of (1) the problem of ash discharge (these coals are classed as high-ash coals), and (2) the problem of igniting the coal promptly and in sufficient quantities. Recently these problems were solved by using a chain grate with a long arch having a steep pitch, the stoker providing a satisfactory fuel bed and the arch the concentration of heat necessary at the stoker gate.

The coals mined in the Red Lodge district have a black color and much luster. They are about as bright as some of the bituminous coals of Pennsylvania, but in contrast to most sub-bituminous coals do not lose this luster when exposed to the air for a short time. However, Red Lodge coals do not stock very well and for this reason must be classed as sub-bituminous, even though in heat value they approach some of the bituminous coals of the Mississippi valley. The ash in these coals is largely due to dirt, which occurs as partings, too thin to be separated in mining. The sulphur content is low. In general, the structure of the coal is such that it can be broken into marketable sizes with only a small percentage of fine coal and slack remaining as residue.

Bear Creek coal from the Red Lodge district has this average analysis, expressed in percentage: Moisture, 15.48; volatile matter, 35.46; fixed carbon, 34.80; ash, 14.26. The B.t.u. as fired is 9354.

Bear Creek coal ingnites freely in furnace having a long sloping arch. Such a furnace is represented in the accompanying illustration; the ratio of active grate area to boiler heating surface is 1 to 37.4. As the boiler was set and in service several years before the stokers were purchased, the distance from the floor line to the bottom of the front boiler header is not so great as modern practice dictates. The high moisture content of the fuel, the thin fuel bed and high chain speed require the greatest possible concentration of heat at the stoker gate. In addition the fuel requires slight moistening. When burning there is a large amount of very light particles of carbon which leave the grate. These ignite and give off an intense white flame. In the particular design shown herewith the furnace volume was relatively small and these particles were carried over into the combustion chamber or stack.



PROPORTIONS OF FURNACE THAT BURNS MONTANA AND WYOMING COALS SATISFACTORILY

For minimum combustible in the ash the coal should be of a uniform size, about ¾ in. (19 mm.) screening, and without an excessive amount of fine coal. Coal having 40 per cent ¾-in. (19-mm.) screenings, 20 per cent ½-in. (13-mm.) and the rest all passing ¼-in. (6-mm.) screen will give the best results. On the tests quoted the coal size was not all that could be desired, owing to there being insufficient fine coal, as already mentioned.

The intense igniting effect of the furnace shown is best illustrated by the statement that a 2¾-in. (69-mm.) to 3-in. (75-mm.) fuel-bed thickness was found advantageous and chain speeds approaching 12 in. (30 cm.) per minute were used.

Results of two tests with this furnace and Bear Creek coal, one at a medium and one at high rating, follow:

	A	B
Per cent combustible in the ash	20.27	18.31
Draft in furnace, in inches	0.18	0.22
Flue-gas temperature, in deg. Fahr	505	613
CO_2 at uptake, in per cent	12.5	12.97
Coal burned per square foot of active heating surface, in pounds	28	38
Per cent builder's rating developed	158	209
Combined efficiency, in per cent	75.8	75.6
Duration of test, in hours	8	8

Another prominent coal from this district is Red Lodge. In general it is very similar to Bear Creek coal, having an average analysis, expressed in percentage, as follows: Moisture, 15.27; volatile matter, 41.24; fixed carbon, 30.91; ash, 12.85; sulphur, 1.31. The B. t. u. as fired is 9553. Owing probably to its slightly higher volatile content, it ignites a little more freely than Bear Creek coal. It burns to a very clean white ash.

Results of tests using Red Lodge coal in a furnace similar to that shown in Fig. 1 show the following:

	A	B
Per cent combustible in the ash	20.71	19.10
Draft in furnace, in inches	0.17	0.17
Flue-gas temperature, in deg. Fahr	531	528
CO_2 at uptake, in per cent	12	12.75
Coal burned per square foot of active heating surface, in pounds	31	30.5
Per cent builder's rating developed	178	182
Combined efficiency, in per cent	73.1	77.8
Duration of test, in hours	8	8

Southeast of the Red Lodge district in Montana, just across the Wyoming state line, is the so-called Sheridan coal field. The various coal beds of this field are very similar. All of them are distinctly black and have a shiny luster when fresh. Exposed to dry air, the blackness is intensified by a partial loss of the luster. At the same time it undergoes a rapid change by the loss of its free moisture, which causes it to crack. Though weakened by this shrinkage, the coal will not crumble for an indefinite period if properly protected from the weather. When it is subjected to alternate wetting and drying, however, it breaks into small lumps and is finally reduced to dust.

Though the coals of the Tongue River group of the Sheridan field contain a comparatively high percentage of moisture and disintegrate on exposure like the lignites, they do not show a woody structure. On the other hand, some of the coals from the other groups of the Sheridan field do show this woody structure. Their main difference from the Tongue River group is a slightly higher moisture content. An average analysis of the Sheridan district coals shows the following percentages: Moisture, 20.52; volatile matter, 31.23; fixed carbon, 30.00; ash, 9.25. The B.t.u. as fired is 9096.

Sheridan coal ignites freely when used in a furnace having a proper igniting effect. To secure the best results, it must be burned with a thicker fuel bed and slower chain speed than is desirable for the coals of the Red Lodge district.

Referring again to the accompanying illustration, results of tests with this furnace and Sheridan coal follow:

	A	B
Draft in furnace, in inches	0.196	0.16
Flue-gas temperature, in deg. Fahr	552	
CO_2 at uptake, in per cent	12.6	11.8
Pounds coal burned per square foot active grate surface	35	30
Per cent builder's rating	195	152
Combined efficiency, in per cent	78.1	76
Duration of test, in hours	8	24

It may be of especial interest to notice that the test at 152 per cent was conducted under normal operating conditions, no provision being made for maintaining a steady load.

The tests here reported are selected from a series. While results obtained are unusually good, they represent no extraordinary efforts with these furnaces. They can, therefore, safely be taken as indicative of the possibilities in using these fuels. With respect to capacity, it may be said that 209 per cent rating represents the maximum secured. Undoubtedly the furnace volume was the limiting feature, as the ignition showed no signs of failure.

Experience with these lower-grade coals clearly establishes the fact that a chain-grate stoker can be used in their firing to solve the ash-discharge problem.

Moreover, the successful employment of chain grates necessitates a long and steeply pitched flat arch to provide quick ignition, as well as a large grate surface, if good overloads are to be secured.

Making Proper Rates for Electric Welding

Question of Central-Station Rates Is of Vast Importance to the Welding Industry—All Factors Should Be Considered Fairly and a Far-Reaching Co-operative Policy Adopted

BY S. I. OESTERREICHER
Member American Institute of Electrical Engineers

WITH the exceedingly interesting and timely comments of C. I. Crippen about making rates for electric welding,* a subject of vast importance to the electric welding industry has been touched upon. The uncertainty which seems to exist upon this subject among central-station interests is no doubt due to the indifference of the welding industry, which during a long period in the past did not assist those affected by the rates as much as its unquestionable duty would have suggested.

While welding installations of only comparatively small sizes had to be considered—say from 25 to 100 kva.—no great harm was done by such tactics to either interest. However, with the installation of large equipments and the operation of large unit welding machines, central stations suddenly experienced disturbances upon their lines and in their stations, which were anticipated but partly and were blamed entirely upon the welding equipment. Thus, to protect themselves, central-station interests launched into a partially retroactive policy, greatly to the detriment of the welding industry as a whole.

Since welding installations of several thousand kva. capacity are not unusual any more, it is proper that all points of doubt should be considered as broadly and fairly as possible, and a far-reaching co-operative policy inaugurated. The revenue from such large installations may easily reach several thousand dollars a month. It is therefore obvious that, from a purely commercial standpoint, a welding load is a very desirable constant source of income to the central station.

Looking at the reverse side, it should be recalled that central-station engineers, on account of past sad experiences, had jumped to the following conclusions:

1. That a welding installation is a very unreliable metering proposition.
2. That it has a poor load factor.
3. It has a constantly fluctuating load varying between extreme limits, and
4. It has a bad power factor.

To aggravate matters all around, usually old or unsuited generators and transformers were installed. These were cross-connected haphazard to carelessly selected nearby pole lines, and then, if trouble developed, all the blame was laid on the welding installation.

During the war the welding industry received a large impetus. For the tremendous advantages which electric welding offered, all the blunders of the past were instantly forgiven. If in the near future the mutual advantages gained recently are lost, the central stations will lose just as much as the welding industry.

To both interests the first important point of the controversy is, no doubt, the metering. The time-honored opinion on one side that, due to the short period involved, an integrating wattmeter does not respond quickly enough, is contradicted by the claim on the other side that the deceleration of the meter disk compensates for the lagging acceleration. As far as the writer is aware, not the slightest positive proof has been offered to support either contention. Considering for instance a 200-volt, 300-amp., single-phase, two-wire wattmeter, whose disk at full load makes 25 r.p.m., and assuming the total energy consumption to be integrated within 0.2 second, it will be found that to register correctly the meter disk has to travel about 0.08 of a revolution. It is scarcely possible that by merely looking upon a meter disk any one could guess within 100 per cent the actual travel during such a short time interval. A stop watch will scarcely be of any assistance; neither will a cycle recorder with an ammeter and voltmeter check be of any value, since no instrument is of such absolute dead beat as to come to rest from no load to full load within 0.2 second. Such methods therefore are of no value in ascertaining the behavior of a wattmeter under sudden intermittent heavy loads.

The next step of the metering proposition was to take

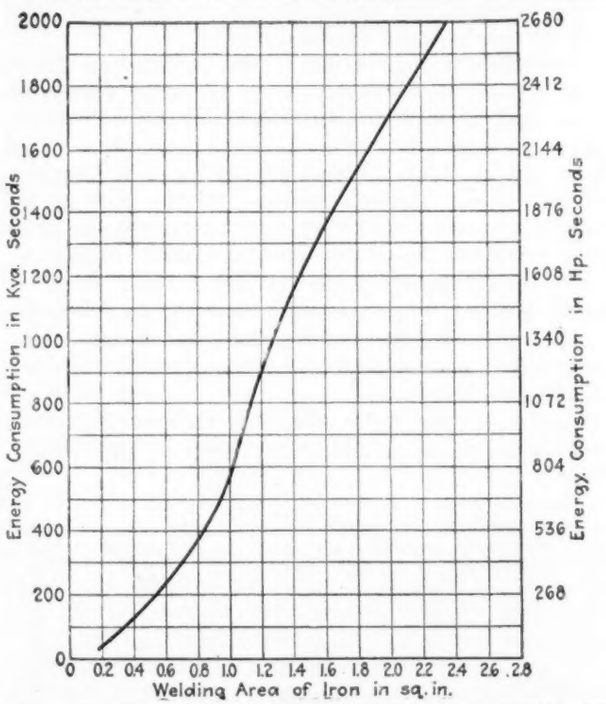


FIG. 1—ENERGY CONSUMPTION OF RESISTANCE WELDING FOR COMMERCIAL GRADES OF SHEET IRON

the rated energy consumption of the welding machine as given by the manufacturer, assume a certain load factor, calculate from these data the energy consumption, correct for the power factor and check the answer periodically on the meter dial. The result obtained on the meter was usually a constantly varying, lower energy consumption than calculated, and no doubt this was the cause of the great distrust of the meter. This

*See ELECTRICAL WORLD of May 31, 1919, page 1173.

method is worse than no check at all, and it is so for the following reasons:

1. The energy consumption at a welder depends upon the welding area of the metal, but is not a proportionate variable. That is, all other factors being the same, two square inches of a certain weld do not consume twice as much energy as one square inch does. Fig. 1 shows this fact plainly. It is also of common knowledge that on a spot welder the area of the weld varies from weld to weld just as much as the electrode contact area does. Assuming an electrode at the start as $\frac{3}{16}$ in. diameter at the tip, after about 200 welds it might be anything

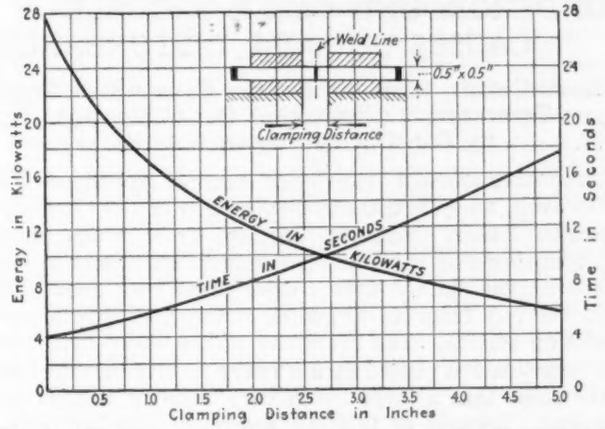


FIG. 2—EFFECT OF CLAMPING DISTANCE BETWEEN ELECTRODES UPON TIME AND ENERGY DEMAND. AREA, 0.25 SQ.IN.

from $\frac{1}{4}$ in. to $\frac{5}{16}$ in. diameter, thus gradually increasing its contact area anywhere from 75 per cent to 175 per cent.

2. On butt welders the energy consumption does not depend upon the size of the weld alone, but also upon the clamping distances. Fig. 2 gives some information about the influence of variable clamping distances upon the energy consumption of welding machines. On a butt welder, the clamping distances increase with the gradual wear of the electrode; thus the above spot welder conditions are duplicated on butt welders also.

3. If no compensation is made to vary the impressed emf. of the welder—and this is never done—then the time must vary from weld to weld according to the condition of the electrode. If the time is changing constantly, the assumed load factor changes correspondingly; thus there are three constantly changing factors in the estimated energy consumptions, beyond any reasonable approximation of the actual facts.

A more reliable method would be a periodic oscillograph test, but this method is rather complicated and expensive and could be done only by large central stations which have both the equipment and the trained personnel for such work.

Such tests, once they are made for certain types of welders and work, will give excellent data from which to check the actual behavior of the standard type of wattmeter. If such comparisons are made, it will be found that the integrated energy consumption of the wattmeter will be larger than the oscillograph test indicates. It is not intended to claim that the wattmeter registers "fast." Laboratory tests are usually made by skilled men, who before the test carefully ascertained all important factors entering into the test, as area of weld, condition of electrodes, welder, emf., cleanliness of material, etc., whereas under normal operating conditions almost no attention is paid by the operator to these considerations. In fact, if the operator works on a piecework or bonus basis, he will conceal as much as possible all discrepancies which have a tendency even temporarily to curtail his earnings. The result of his policy has a very important effect upon the wattmeter.

Summing up the metering proposition and speaking from experience on large welding installations with capacities over 250,000 sq.in. of welding per month, where ten to fifteen butt welding machines are constantly thrown on or off the supply circuit, it is safe to claim that in such installations the standard alternating-current integrating wattmeter is on the job.

THE LOAD FACTOR

The present-day tendency in resistance welding practice is to perform the weld as quickly as possible without injury to the metal, but fast enough to prevent imperfection at the weld. Having in mind large welders with 5 to 15 sq.in. weld capacities, this tendency will give a unit load factor not much over 10 per cent per welder. From the central-station viewpoint, this factor is certainly very low and undesirable.

However, two important circumstances alter the condition considerably. The first point is that in large installations one large welder will not suffice to do all the required work, therefore several will have to be installed. Owing to the big energy demands these large welders never operate simultaneously. While one welds the next is cleaned, the third is prepared, the fourth is waiting for the signal to weld, etc.; thus the load factor of the installation as a whole is considerably over 10 per cent and nearer to 20 per cent. Another natural circumstance of large installations is the fact that not all work requires large welders. There are usually ten to fifteen smaller welders installed, of which 30 per cent might work intermittently with the larger welders. Thus it will be seen that the load factor is bad only in small installations connected to small central stations, while large installations, which necessarily must receive their supply of energy from comparatively larger central plants, have rather a good aggregate load factor, reaching well up to 25 to 30 per cent.

Another point for consideration is the fact that, owing to its temperature, a large work cannot be handled immediately after welding. The work must cool off before additional operations can be performed upon it. The cooling takes some time. In several instances it was found desirable to shift the working hours of the welding crew several hours ahead or behind the working hours of the rest of a factory, for the sole reason that there should be on hand sufficient cool welded work for the successive manufacturing steps. If this time-shifting is selected to coincide with the low-point period of the load factor of a central station, then there results an actual all-around improvement. For this the welding installation should be entitled to a certain proportionate consideration.

MAXIMUM DEMAND

Owing to the instantaneous severity of a welding load, demand upon a supply station seems to be of considerable importance. However, the shifting of a load factor toward an off-load period, as described, will certainly take the severest effects off the system. Under such conditions regulation of the supply system suffers only in small plants, and only in places where lighting and power loads are fed from the same mains.

But large welding installations are usually direct-connected through transformer banks to the station buses, where the fluctuating character of the welding load will be almost negligible and certainly will not affect the regulation of a system in a degree commensurate with the size of the connected welding installation. Of course in all these discussions it is assumed that the station apparatus, transformers and supply feeders are properly selected, with equipment properly calculated to fit the particular welding load. In the past this has not always been the case, and this is one of the causes of so many different maximum demand charges.

The ratio which the maximum demand should bear to the connected load will always remain a local issue between producer and consumer. The ratio should, however, be made to depend on the average kilovolt-ampere energy demand of all the welders (and not on their rated capacities as given by the manufacturer) and of the rated capacity of the primary supply installation. If the welding customer bears a part of the installation charges caused by larger transformers and larger supply mains, he should benefit by the resultant mutual advantages. However, no demand charge should be based upon a mixed welding and motor load supplied from a common primary installation. The importance of this claim will be more evident if it is stated that by separating a certain mixed welding and motor circuit, and by installing an additional 100-kw. equipment, the maximum-demand charge in a single supply circuit in one month was reduced over $200.

To be sure that no more disturbing overloads are thrown upon the line than have been contracted for, overload relays, time clocks and maximum-demand indicators will be found sufficiently reliable for all honest purposes on both sides of the controversy.

Proper grouping of the single-phase welding loads upon a three-phase supply system will give perfect satisfaction in almost all installations but those of small size.

POWER FACTOR

So much has been said and so much worry caused about the poor power factor of a welding installation that it is now universally accepted that the power factor is bad, and nothing further is done about it. The outstanding feature about this condition is that the central stations, in a most unfortunate moment, decided to "penalize" the power factor. It is not the charge for the condition, but the adoption of the word for the charge, which makes the customer balk and is the cause of no end of distrust toward the welding machine. The word "penalty" conveys to the lay mind the impression that a poor power factor exists only with welding installations, and naturally the conclusions are not flattering for the welding equipment.

No attempt is made here to describe the well-known methods of improving the power factor of a welding installation with synchronous apparatus. The adoption of such methods is more of a commercial than an engineering problem. Upon investigation it will be found that, with few exceptions, it is cheaper to pay for the poor power factor than to invest in additional apparatus. However, the average power plant usually has, besides a welding installation, a number of other consumers, the effects of whose poor power factor are felt in considerable measure at the generators. If all such sources are investigated and segregated upon one common bus, together with a welding load, it might be found that either a synchronous or static apparatus would more than pay for itself, if installed at the proper place.

If this fact is explained to a welding customer, there can be no doubt that he will be only too eager to bear a certain proportion of the investment for a special apparatus and thus secure for himself a better rate for the consumed energy. With proper co-operation between the central station and the welding customer on all these points of mutual interest, much misunderstanding and distrust could be eliminated, benefiting all parties concerned in the welding industry.

UNDERGROUND CABLE TROUBLE CAUSES UNUSUAL DISTURBANCE

Short Circuit Close to Busbars Causes Two Large Generating Stations to Fall Out of Step and to Trip Out Substation Rotaries

A rather unusual disturbance occurred recently on the 9000-volt, 25-cycle transmission system of the Commonwealth Edison Company, Chicago, from which some interesting and valuable observations have been made. The trouble started with a cable breakdown about 200 ft. (60 m.) from its oil switch at the Fisk Street generating station. The proximity of the short circuit to the station bus caused such a heavy flow of current into the fault that a large momentary drop in voltage resulted. Because of this the groups of affected turbo-generators, with a capacity in operation of 65,000 kw. at Fisk Street and 50,000 kw. in the Northwest station, lost their loads of synchronous converters, speeded up and dropped out of synchronism with each other. All efforts to restore normal voltage were nullified for a few minutes by a flow of wattless current in the tie line between the two stations. These various complications were not immediately made clear to the load dispatcher's office because of the vast number of telephone calls which were necessary to take care of the situation in the affected substations. Consequently the restoration of the generating stations to normal was somewhat delayed. In order to re-establish synchronism the tie line between the affected and the normal sections of the generating stations was opened up and the machines then picked up load.

A number of minor difficulties were experienced in some of the synchronous converter substations, and in one instance a 1000-kw. machine was seriously damaged. This was due to the failure of its protective devices to function completely. Meanwhile the unequal supply of energy from the various substations to the underground direct-current system caused the blowing of many fuses in this network, and in two instances manhole fires resulted.

About one hour and forty minutes after the "blow-out," when the restoration of service was well under way and pressure was again up to normal in most parts of the system, a second short circuit occurred in a section of the Fisk Street switch house which had not been affected by the earlier trouble. The disturbance from this second short circuit was much more limited than in the earlier case, but, coming right on top of the first, it resulted in the blowing of more fuses in the downtown district. However, the newspaper presses, the theaters and other important customers had full energy when needed and the entire system was practically normal early in the evening.

Maximum-Rated or 50-Degree Motor

Argument for the Continued Use of a Motor with Good Factor of Safety—It Is Held that the Slight Saving in First Cost of a 50-Degree Motor Is Overbalanced by Greater Maintenance Expense

BY A. C. BUNKER
Chief Engineer Crocker-Wheeler Company

DURING the last few years there has been an increasing agitation on the part of some motor manufacturers to introduce a new type of motor ostensibly in the interest of the motor-buying public and to have in its favor general economic considerations. The maximum-rated or 50-deg.-rise standard is to be applied to commercial motors which have their electric circuits (armature, fields, etc., or rotor, stator, etc., as the case may be) insulated with cotton, silk, paper or similar materials, treated or impregnated with varnishes, gums or other insulating compounds similar to those used at the present time on the 40-deg. standard machine.

Some years ago the American Institute of Electrical Engineers established a maximum limit of temperature beyond which insulation must not be used, but this does not justify manufacturers in subjecting insulation to this upper limit as a normal condition. It is just as necessary in electrical apparatus to provide a margin or factor of safety, in order to meet the wide variations in service conditions, as it is to allow a factor of safety in the building of a bridge or anything else.

In every branch of engineering a reasonable factor of safety has always been considered essential, and indeed, the chief duty of the engineer is to make sure that proper precautions are taken, not only for ordinary conditions but for contingencies that are practically sure to arise sooner or later in actual service. Electrical machinery is not essentially different from other kinds of machinery and should not be designed with zero factor of safety nor made the only exception to a heretofore universal and unquestioned rule. Experience is always proving that defects may exist, accidents may occur, emergencies may arise, conditions may change, demands may increase, and various other things may happen. These are too numerous and difficult to foresee always or to provide for except by relying upon our good and tried old friend "safety factor."

The very expression "maximum-rated" clearly discloses the absence of any factor of safety. Probably for that reason the camouflaged designation "continuous-rated" is often used. It is certainly no more continuous than the 40-deg. standard with its overload capacity. Hence it is also called "single-rated" in order to get away from the self-indictment of maximum-rated. This is merely evasion. Evidently advocates of the maximum-rated standard either forget or were not closely enough in touch with the art twenty years ago to remember that some manufacturers then made maximum-rated machines and that until the standard of rating was changed makers and users lived through expensive troubles, one cause being the roasting out of coils if operating conditions were not good.

Standards were later changed to provide machines having more margin in capacity and to conform in general to 40-deg. temperature rise. (Some manufacturers even went further and produced machines on a 35-deg. rise temperature basis.) This departure from the maximum-rated standard resulted in machines which gave and are giving general satisfaction to users.

One of the arguments for the 50-deg. motor is that standardization, lower overhead charges, simplified factory methods and interchangeability can be more easily accomplished by departing from present standards and adopting this new maximum-rated standard. It is also claimed that the present 40-deg. standard is the result of individualistic effort, although no logical explanation has ever appeared which would indicate how either a 40-deg. or a 50-deg. standard has any relation to, or is in any way an evolution from, either an individualistic or a collective effort. It is quite certain that manufacturers can apply their collective efforts to a 40-deg. standard with much less disturbance and expense both to themselves and to the public than they could to a new standard.

TEMPERATURE LIMITS AS DEFINED BY A. I. E. E.

The user of a motor should acquaint himself with just what the A. I. E. E. Rules say in regard to this temperature rating. The A. I. E. E. Rules, revised 1918, page 35, paragraph 375, sixth line, under the subject of "Temperature Limits," say: "Whatever be the ambient temperature at the time of test, the rise of temperature must never exceed the limits in column two of the table." The table referred to is that given on page 36 and shows that the temperature rise (maximum) should never exceed 65 deg. C. This allows for limiting observable temperature rise of 50 deg. and 15 deg. for hot-spot correction. So that should the ambient temperature be say 10 deg. C., then the highest hot-spot temperature should not exceed 75 deg. C., or the observable temperature should not exceed 60 deg. C. It is necessary therefore for the user of the maximum-rated motor to be very careful on this point. When this necessity for precaution becomes more generally known it will probably cause a reaction.

Of course, in recent years improvements have been made in motor design and construction; but so far as insulating material is concerned, we could get just as good cotton, paper, varnish and gums twenty or more years ago as we can to-day, and coils for commercial motors are not made much, if any, better now than they were then. Such changes as have been made have been along the lines of getting more out of material than heretofore, reducing to some extent and under some circumstances the excess or hot-spot temperatures; but little, if anything, has been done to permit fabric or varnishes to stand up under higher temperatures.

Advances have been made in the application of motors, but even so, some large users are to-day deliberately ordering 40-deg. motors which are larger than called for by the connected load so as to provide a still larger factor of safety and thus insure in case of accident that any breakage of shafts or pinions will be

external to the motors. Some motor buyers are actually specifying 35-deg. temperature rise on what would be called commercial motors.

The Power Club, the membership of which is made up from representatives of all motor manufacturers, is not unanimous as to the advisability of adopting the maximum-rated or 50-deg. rise standard, and after long discussion on the subject a compromise was arrived at allowing two standards, so that we are worse off than we were with the old 40-deg. standard. Moreover, the Power Club in its publication says (5303):

"2. Machines having 40 deg. rating are designed for all classes of service, including those in which an overload capacity of 25 per cent for two hours is desired.

"3. Machines having 50 deg. rating are designed for conditions in which the load requirements are *accurately* known and under which the machine *will not be* subjected to loads in excess of its rating." (Italics are the author's.)

If the manufacturers of motors cannot arrive at a unanimous agreement on this subject, and in order to keep the peace consent to two standards, and if they deem it necessary to print the above explanation, is it not reasonable to expect that there is much doubt as to the desirability of this new rating?

The advocates of the maximum rated or 50-deg. standard are largely confined to the manufacturers because buyers generally, especially if they know anything about motors, want a motor to use, and do not intentionally buy repair bills, loss of output and trouble with their own customers when they buy motors. In buying motors, as in everything else, some users are too prone to save on first cost, especially if they have the support of plausible arguments.

SPECIFIC ARGUMENTS FOR 50-DEG. MOTOR ANSWERED

Motor users should consider some of the arguments of the maximum-rated advocates because these arguments at least indicate the points upon which there is a difference of opinion. The following are a few of these arguments noted in the ELECTRICAL WORLD, May 12, 1919, and elsewhere:

(1) The large number of well-trained men now engaged in the application of motors and the unusual desire to do things better to-day than yesterday mean that the motors must now be selected with a greater degree of accuracy than was considered essential in the early days.

This means that in order to prevent having trouble with this new type of motor a well-trained man must be employed or consulted, and a greater degree of accuracy is necessary in determining what the actual load will be than heretofore. In other words, if you must de something and then do not do it, a penalty follows.

If a factory or plant is of such size that growth or other conditions require several motors to be kept in a storehouse, and if these are the maximum-rated or 50-deg. motors, then before one of these spare motors can be used an expert must carefully investigate the load which it is to carry. If the location is dusty, if the ventilation is not good, or if the motor is to carry 10 per cent, 15 per cent or 25 per cent overload for an hour or so, or if the voltage or frequency is low at times, or if the voltage is high at times, then this motor will not do according to the quoted statements. It is then necessary to run the risk of burning up another motor, or procure a larger motor or at approximately the same price a 40-deg. standard motor. Experience has taught that if this is done in the first place expense and delay are saved.

(2) It is better to have a motor underloaded than so heavily loaded that it cannot operate successfully.

Why then a maximum-rated motor? The argument in favor of the 40-deg. standard has always been that there should be a margin between the nominal rating of the motor and its ability to carry overload, and this leeway in actual service has been none too great.

(3) Ample margin must be allowed between the requirements of the driven machine and the maximum torque developed by the motor.

It is a physical fact that a 40-deg. motor has a greater capacity for torque relative to its rating than a 50-deg. motor would have, both motors being commercial motors and designed for these respective temperatures.

(4) It might appear that a motor which has a temperature rise of 40 deg. will have a longer life than one designed for 50 deg. As previously pointed out, this is not true.

In certain picked cases this may be true, but this statement is fallacious for motors in general service.

(5) Compare the factor of safety of a motor rated in the old way with that of a motor rated in the new. Was the purchaser any better off?

This statement is decidedly illogical. A 40-deg. motor can be selected with just as much intelligence as a 50-deg. motor can be, and the inherent margin of the 40-deg. motor would still be available for the exigencies of service conditions.

(6) This new and simplified method of rating places on the purchaser the burden of determining the appropriate margin to be provided.

This statement shows that the motor user is made responsible for every step in selecting and using the motor he is to buy, and if later anything goes wrong with the motor, one or another of several limitations which might or might not have been exceeded are excuses which prevent the user from getting any redress. In the event of trouble the evidence will in many cases be destroyed, or hard or expensive to obtain, so that the only thing left for the user to do is to pay for repairs or replacements.

(7) Let it be universally understood that the 40-deg. rating is 83⅓ per cent of the name-plate rating of a continuous-rated motor; another method of obtaining the 40-deg. rating from a continuous-rated motor is to de-rate to the next even rating.

If a 50-deg. shunt motor is carrying full load and is new and clean, the temperature rise of the shunt fields being 50 deg., a 16⅔ per cent reduction of its load will not lower the shunt-field temperature to 40 deg.

(8) Under the continuous-rating system the purchaser will know exactly what he is getting and pay for that only.

It is little consolation to know that a motor has to be hedged about by every safeguard, the particular application passed on by well-trained men; that it will not stand any overload except momentarily and that by no possibility must the motor be subjected to unfavorable conditions.

(9) It should be realized when applying these motors that it is particularly unwise to assume that because a 10-h.p. motor when 25 per cent overloaded for two hours (40-deg. motor) did the work, a motor of the same continuous capacity will do the same work.

This is a definite condemnation of the 50-deg. motor by a 50-deg. advocate. If a 40-deg. motor were carrying its overload capacity at times, the 50-deg. substitute of the same nominal rating would come to grief.

Another reason (No. 10) advanced for the maximum-rated or 50-deg. standard is that "From an economic standpoint we should save all material possible." If it is necessary to select a larger motor to be as safe as this type of motor will permit, and as this next larger size weighs and costs practically the same as the standard 40-deg. motor, is there then any economic saving?

No damage to fabric insulation will result if it is subjected to the upper limit of temperature as given by the A. I. E. E., provided that this limit is not exceeded. It is, however, quite another matter when this insulation is put in a motor and subjected to service conditions. Assume that the 50-deg. motor will meet its temperature guarantees when it is new and clean and on the test floor, but what happens after the motor has been in service several weeks? Even in a relatively clean place the radiating surfaces will be covered with dust.

What is going to happen when these 50-deg. motors have the air-ventilating ducts even partially clogged up? Is it customary or practicable to clean out ventilating ducts of 40-deg. motors? Does a user want a motor in which these ducts must regularly be cleaned out? What happens if one of these motors is installed close to the power house or source of supply where the voltage supply may be 10 per cent above normal?

Temperature May Rise Owing to High Voltage

Increase in temperature rise is very nearly proportional to the increase in voltage. Under some applications it is more. It is not uncommon to find circuits having a voltage variation due to line drop as much as 10 per cent, so that if one of these maximum-rated motors were to be installed near the source of supply or center of distribution its temperature would no longer be 50 deg. but something higher. A direct-current motor, for instance, operating a fan or pump and subjected to an increase in voltage will have its temperature rise increased, owing both to the increased load and to the increased field temperature. Sometimes these motors are required to operate under low voltage, say only 10 per cent reduction. It is certain for a given load that the armature, in case of a direct-current machine, would be required to carry heavier currents.

On a cold Monday morning, after a factory or plant has been shut down over Sunday, a motor is required to carry from 15 to 30 per cent more load for an hour or more until the shaft, bearings, etc., get warmed up and better lubricated. Maximum-rated motors, not having any overload capacity, are not suitable for these conditions.

Many times it is very desirable to put on a little extra load, perhaps temporarily, but often as a regular condition. Many times this happens without the knowledge of any one qualified to determine motor capacities.

In a large number of cases it is not possible to control all of these conditions all of the time, and if motors are used which have no overload capacity, it is inevitable that sooner or later they will be subjected to overloads or the equivalent in the different conditions of operation.

Power Must Be Sufficient to Insure Production

The experience of motor users is continually showing that the loss in output from a motor being down represents far more than the difference in price between a maximum-rated and a 40-deg. machine. In these times, when production is more vital than ever before, motors should have enough capacity and margin so that when they are put in service they can be forgotten and trusted to pay their own way in the plant.

In looking over literature published by the suppliers of this maximum-rated motor it is noted that they are designated under different headings, namely, maximum-rated, 50-deg. rise, single-rated and continuous-rated. These terms refer to the same motor. One supplier states that these motors have no sustained overload capacity and care must be exercised in analyzing the conditions of load to which they are applied, and it is further mentioned that a ¾-hp. rating under the double system of ratings heretofore prevailing (meaning 40-deg. rise standard) may have been successfully used for driving a machine which required ¾ hp. normally but at times had as much as 1 hp. With a continuous rating ¾-hp. is obviously not adapted to meet this condition. A 1-hp. continuous-rated motor should be used.

Another supplier states that 50-deg. motors continuously rated are guaranteed to operate at a temperature rise of 50 deg. for full-load continuous service without overload temperature guarantee. They should only be specified for conditions for which the load requirements are actually known and under which the motor will not be subjected to loads in excess of its rating. Other examples of caution in the use of these motors are given. There must be some reason for all this caution and explanation regarding 50-deg. motors, and it is not clear why a buyer should pay more per pound for material in a 50-deg. motor than in a 40-deg. motor.

The maximum-rated motor has been on the market a relatively short time, but enough experience has been gained to justfy the caution that is required in its selection. It is not difficult to find users who are going back to the 40-deg. standard motors and refusing to reconsider the 50-deg. standard motor.

Is there any real justification for the needless risk in using one of these motors, or any logic in buying the next larger size 50-deg. motor, in order to be somewhere nearly as safe as with a 40-deg. motor, especially when the two motors cost approximately the same? Is it not far safer to continue with the 40-deg. standard that has been tested and found satisfactory through long years of operating experience?

IT HAS been said that the reconstruction period through which we are now passing is even more trying than the five years of actual world warfare. The effects of the war are being felt now from both economic and psychological standpoints. Economically the operation of the law of supply and demand would work out the situation, were it not that this law is obstructed by certain unpatriotic action familiarly known as profiteering. Psychologically, the public mind is still affected by five years of anxiety, and it is but natural for it under these circumstances to react to all kinds of extremes. It seems to me that the need of the time is for us all to go forward with courage in the regular pursuit of our business, laying stress upon the necessity for more production, more economic saving and more conservation.—*R. H. Ballard.*

Readers' Views and Comments

Possibilities of Standard Transformers for Rural Lines

To the Editor of the ELECTRICAL WORLD:

SIR: It is not economical to purchase 6600-volt transformers which are only insulated to withstand a test of 14,200 volts (A. I. E. E. standard) when for about 5 per cent more money a transformer can be purchased which will withstand the manufacturers' standard test of 26,000 volts. This is the opinion of a large manufacturer of transformers, and it applies particularly to the small transformers installed on rural lines. The manufacturer has also pointed out that with the proper transformer taps it is possible for utilities greatly to increase the capacity of their rural lines without having to buy new transformers for the higher voltage. It is not feasible to do this, however, with transformers which are only insulated for a 14,200-volt test, even if they are rated at values large enough for the customers' requirements.

There appears to have been a tendency to underestimate a farmer's transformer requirements. Manufacturers were originally asked to produce 2-kva. transformers of the 13,200-volt class; then the demand increased to 3 kva., and now the greatest call is for 5-kva. transformers. The smallest 6600-volt transformer made by this particular manufacturer is rated at 1.5 kva. Smaller transformers of this voltage class could be supplied, but, judging by past experience, the requirements of most rural consumers soon exceed the safe carrying capacity of such a small transformer.

Chicago, Ill. S. N. CLARK.

Consideration of Efficiency in Purchasing Motors

To the Editor of the ELECTRICAL WORLD:

SIR: In the mind of the average purchaser of an electric motor the most important consideration is generally that of price. The efficiency of the motor is not usually taken into consideration at all and in most instances is not even mentioned. In fact, the question of efficiency is so seldom discussed that the average purchaser has a very vague conception of what motor efficiencies should be. But were the purchaser to concern himself seriously with this question he would find that it is often of as much importance as the question of first cost.

Motor design has in general been pretty well worked out and basic patents have expired, so that it is fairly safe to say that no one manufacturer possesses any great advantage over the others in the way of increasing the efficiency of his product. The result is that the efficiencies of standard makes of motors run pretty well together.

But manufacturing costs may be cheapened at the expense of efficiency, and if a purchaser considers first cost only he may in a few years pay out the equivalent of the first cost of the motor in excess power bills. Assume, for example, a 10-hp. motor operated ten hours per day with energy at 5 cents a kilowatt-hour. With 300 days' operation per year each point in efficiency makes a difference of about $10.50 annually. But as the ordinary motor user would not be likely to detect a deficiency of 10 per cent below the average, after having installed the motor, it behooves him to know what he is buying.

In addition to protecting one from the manufacturer who might build to cater to the first-cost man, a familiarity with motor efficiencies will in numerous instances help in selecting the proper motor for the service. At times a close consideration of efficiencies may show it advisable to do what would otherwise seem absurd.

If changes in factory were to permanently reduce the load on a 5-hp., 60-cycle, three-phase motor to 1½ hp., offhand judgment would probably decide in favor of the 5-hp. motor. However, efficiency tables at hand give the smaller motor at full load an efficiency of 80 per cent and the larger one at one-fourth load an efficiency of 71 per cent. On the basis of 300 days a year, ten hours a day and 5 cents a kilowatt-hour, there is a difference of approximately $24 per year in the power bill in favor of the 1½-hp. motor. In other words, the smaller motor would pay for itself in three or four years.

Again, various types of alternating-current motors have different efficiencies. In general the squirrel-cage motor is highest. The wound rotor of the slip-ring motor, the brushes and the external circuit introduce resistance losses which in general lower the efficiency of this type of motor a few points. Likewise the winding and mechanism of the single-phase motor tend to reduce its efficiency. A study of the efficiency tables of these types may result in a decision to go to a considerable expense to insure the installing of the proper motor.

Practical considerations compel manufacturers to depart somewhat from the most efficient designs of motors. There is, of course, one frame size. one size of lamination, slot, wire, etc., best suited to build each rating of motor. But the number of ratings is so great, as may be conceived by considering the different horsepowers, speeds, frequencies and phases of alternating-current motors in commercial use, that it is practically impossible to provide each rating with its theoretically correct frame and stamping. Consequently one size of these parts must be used for several ratings. But as there is one rating best suited to the frame there may be one rating with highest efficiency. As a consequence efficiency tables show quite a little variation for different sizes and also for the different speeds of the same horsepower. For instance, the tables of one manufacturer show a squirrel-cage motor of 10 hp., 1800 r.p.m., to have an efficiency of 86, while the 1200-r.p.m. motor of the same horsepower is credited with 89 per cent. Similar unexpected and irregular variations appear here and there throughout the tables.

The point at hand is that this 3 per cent gain is of value. However, unless efficiency is given consideration in the selection and purchase of motors, it and similar gains may be replaced by losses so obscured that they may never be realized and will therefore in the end prove extremely expensive to the purchaser of the machine.

Albion, Ill. ALBERT MCCALL.

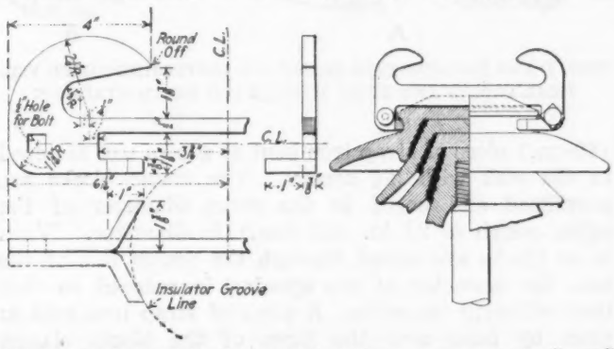
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SIMPLE LIFTING TOOL FOR HIGH-TENSION LINES

Consists of a Clamp Fastened to a Pin Insulator Screwed on End of Insulating Rod—Can Be Used to Hold "Hot" Line to One Side

For changing insulators on "hot" high-tension lines a simple lifting tool has been developed which can be used to pick up the wire on an overhead line and hold it to one side while the insulator is being replaced. The clamp is of cast phosphor bronze, the mixture recommended consisting of 10 lb. (4.5 kg.) of copper to 1 lb.



METAL JAW CLAMPED TO PIN INSULATOR FOR HOLDING "LIVE" WIRES AT DISTANCE WHILE RENEWING INSULATORS

(450 g.) of phosphor tin. Two castings, shown in the accompanying sketch, are required in order that the device may be fastened into the clamping groove of the insulator. With this arrangement the device is sufficiently strong for employment under maximum service conditions.

The dimensions given in the sketch are to fit Ohio Brass Company's insulator No. 10,748, but with proper modifications a clamp of this type could also be used on other insulators.

H. E. WEIGHTMAN,
Engineering Service Company, Chief Engineer.
Chicago, Ill.

INSUFFICIENT INSULATION CAUSE POLE-TOP BURNS

Excessive Leakage of Current Shown by Charred Paths Visible on Cross-Arms Near Steel Pins—Pins Tied Together Electrically

On the 224-mile (360-km.), 60,000-volt line of the Southern Sierras Power Company some trouble had been experienced in the burning of wooden pole tops. The poles are of Oregon pine 35 ft., 40 ft. and 50 ft. (10 m., 12 m. and 15 m.) in height and are placed 260 ft. (80 m.) apart. The conductors are arranged in an equilateral triangle with 72-in. (1.8-m.) spacing. Side pins are of 2-in. (5-cm.) tapered iron pipe with lead threads, and the top pin straddles the top of the pole.

The burning of the pole tops usually started at the point where the cross-arm through-bolt passed through the arm and pole. The fine charred paths visible on the surface of the arm near the iron pins showed that there was excessive leakage of current.

To overcome this leakage of current, the three pins were bonded by means of No. 9 galvanized-iron wire. This wire was electrically connected to the pins by making a loop on the ½-in. (13-mm.) bolts that hold the pin to the pole or in the cross-arm. In order to protect the man who bonded the pins, the wires were stapled to the arm and to the pole before they were connected to the pins. A crew of two linemen and one groundman bonded this line while it was in operation. Since that time there has been no pole-top burning due to leakage of current.

Riverside, Cal. R. H. HALPFNNY.

BOSTON EDISON STOKER AND CONTROL EQUIPMENT

Sectionalized Mechanism Is Employed for Motor-Driven Coal Feed—Indicating Instruments Facilitate Service

The stoker drive and boiler-plant equipment at the L Street generating station extension of the Edison Electric Illuminating Company of Boston, Mass., are of interest as an illustration of the importance of flexible means of operation under modern conditions of energy production. The boilers recently installed (Fig. 1)

FIG. 1—DRAFT GAGE, TACHOMETER AND STOKER CONTROL LEVERS, WITH PRESSURE PIPING BEHIND INSTRUMENTS

are of 1232-hp. rating and of the cross-drum type. Each has a total heating surface of 12,322 sq.ft. (1110 sq.m.) and is equipped with double-tube super-heaters having 3174 sq.ft. (286 sq.m.) of heating surface. The boilers, which are of the B. & W. type, are equipped with

Westinghouse thirteen-retort underfeed stokers (Fig. 2), the total grate area per boiler being 207 sq.ft. (18.7 sq.m.).

The stokers are installed under the mud drums, and each stoker is sectionalized into four parts with separate drive and draft regulations. The four driving motors are Westinghouse direct-current interpole motors, type S. K., 110-volt, with continuous rating of 5 hp., 550 volts, 8.3 amp., 450 to 975 revolutions. The drive is obtained through sprocket and chain and clutch to double-worm gears.

Fig. 1 shows the other end of the same installation. The meters and controls are on the fronts of the boilers. For each of the four separately controlled sections there is a precision gage indicating the draft under the fire and a tachometer indicating the rate at which coal is being supplied by the stoker. At the middle of the boiler two draft gages are mounted, one indicating the draft over the fire and the other draft at the uptake.

A Bailey boiler meter is also mounted at this point which records on one chart the steam flow, air flow and the flue temperature. Back of the meters may be seen the pressure piping to the various meters.

Directly under the four sets of section meters are four levers which operate through chains to the rheostat controls of the stoker motors. These boilers are equipped with clinker grinders which are flanked with adjustable aprons for dumping. The aprons for each section are operated independently by the wheels shown at the base of the boilers along the floor.

At the side of the boiler not shown in the cut is a lever for throwing the clinker grinder in and out of

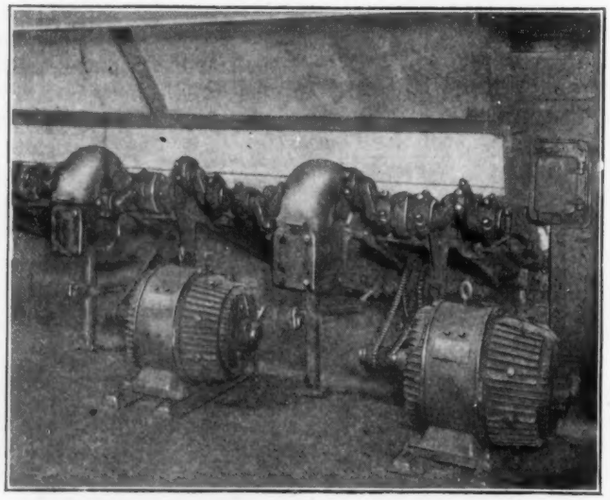


FIG. 2—VIEW SHOWING ONE-HALF OF THE STOKER DRIVE FOR ONE BOILER UNIT

gear. Four other levers at the sides of the boiler operate dampers to each section under the fire.

The boilers are operated with a standard relationship between air flow and steam flow and with minimum flue temperature. These indications are given by the Bailey boiler meter. The policy of operating the furnaces by means of these observations has proved very satisfactory.

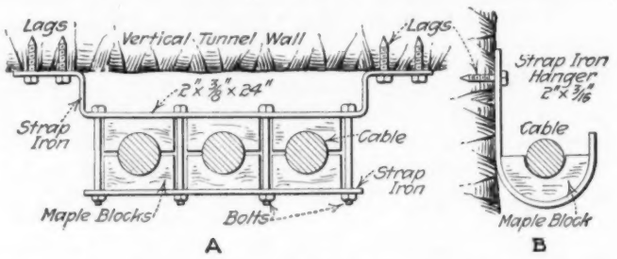
GEORGE R. DAVISON,
Superintendent Technical Division, Generating Department, Edison Electric Illuminating Company of Boston.

SUPPORTS FOR VERTICAL AND HORIZONTAL CABLES

Maple Blocks ext to Lead Sheath Prevent Abrasion —Vertical Cables Supported Every 4 Ft., Horizontal Ones Every 5 Ft.

Two types of cable supports used by the Cleveland (Ohio) Electric Illuminating Company are shown in the illustration—one for three vertical cables and the other for single horizontal cable. Both are adapted to No. 4/0 lead-covered 11,000-volt cable.

The main vertical support used for the power cables consists of a 2-in. (50-mm.) by $\frac{3}{8}$-in. (9.6-mm.) by 24-in.



FIGS. 1 AND 2—GANG-TYPE CLAMP FOR SUPPORTING THREE VERTICAL CABLES AND STRAP HANGER FOR HORIZONTAL RUN

(60-cm.) piece of strap iron bent as shown and fastened to the wall with lag screws. The maple blocks are paraffined and bored to the exact diameter of the cable, which is $2\frac{5}{8}$ in. (65 mm.) in diameter. When these blocks are sawed through the center line of the hole the diameter of the opening is reduced so that they will grip the cable. A piece of strap iron held in place by bolts over the faces of the blocks clamps the blocks over the cable. These wall hangers are placed at 4-ft. (1.2-m.) intervals.

For supporting the horizontal runs in tunnels a simple hanger (*B* in figure) was designed. This consists of a piece of wrought-iron strap 2 in. by $\frac{3}{16}$ in. (50 mm. by 4.7 mm.) bent into a hook shape and drilled at one end to take a lag screw. A semi-circular maple block rests on this hanger and is bored to fit the periphery of the cable. The blocks are prevented from working out of the hook by the cement fireproofing which covers the full length of the cable. The hangers on the horizontal runs are placed on 5-ft. (1.5-m.) centers.

DATA ON PAPER-INSULATED LEAD-JACKETED CABLES

Working Pressure and Tests of Y-Connected Neutral-Grounded Circuits—Preferable to Open-Delta-Connected Circuits

Although impregnated paper, used for insulating high-tension cables, has the tendency to absorb moisture and requires a waterproof outer jacket and the careful sealing of ends, it is probably the most widely used and generally the best available for this service. It will stand higher operating temperatures with a lower rate of deterioration than rubber or varnished cambric and has high dielectric strength.

The accompanying table presented by Wallace S. Clark of the General Electric Company before the convention of the New England Section of the National Electric Light Association indicates the range of conductor cross-

section obtainable in paper-insulated cable if the overall diameter is limited to 3 in. (7.5 cm.) and the smallest cable is limited by allowing a tension of about 90 volts per mile at the surface of the conductor.

Some companies have changed from this type of circuit to an open-delta, but this method is not so economical. The advantages of the star-connected system over the open-delta circuits are that it has a higher kilowatt capacity in a given duct and a minimum cable cost for a given kilowatt capacity. If a three-conductor No. 4/0 15,000-volt cable with 6/32-in. by 6/32-in. (4.8-mm. by 4.8-mm.) paper insulation cost $1 per foot, a three-conductor No. 4/0 15,000-volt cable with 6/32-in. by 3/32-in. (4.8-mm. by 2.4-mm.) paper insulation would cost $0.90, which indicates quite a saving if the "Y" connection is used. A comparison of change of voltage and connections shows that a three-conductor, 500,000-circ. mil., 15,000-volt, delta-connected, 325-amp., 9400-kva. cable would have a loss of about 8 watts per duct foot and would cost $1 per foot, whereas a three-conductor 350,000-circ.-mil., 25,000-volt, star-connected, 250-amp., 11,000-kva. cable would have a loss of only 7 watts per duct foot and would cost only $0.88. Therefore the star-connected grounded system would have an increased capacity of 30 per cent, a decreased investment of 12 per cent and a decreased transmission loss amounting to 12½ per cent.

THREE-PHASE PAPER-INSULATED LEAD-JACKETED CABLES
For Y-Connected Neutral-Grounded Circuits

Working Pressure, R.M.S. Volts	Insulation On		Minimum Cable	Maximum Cable	Five-Minute Test Voltage	
	Each, (In.)	Belt, (In.)			Between Conductors	To Earth
30,000	7/32	11/32	3/0	3/0	75,000	45,000
25,000	7/32	7/32	1/0	250,000 circ. mil.	62,500	37,500
15,999	11/32	5/32	2	650,000 circ. mil.	37,500	22,500
10,000	7/32	7/32	7	750,000 circ. mil.	25,000	15,000

LIMITATION TO OUTPUT REMOVED BY MODIFYING RHEOSTATS

Expedient Adopted at Holtwood (Pa.) Station for the Purpose of Facilitating Maximum Use of High Water Flow

On account of the large reactive loads thrown on the Holtwood plant of the Pennsylvania Water & Power Company during the high-flow season, the generators are subjected to electrical loads heavier than their rating. This overload and the high bus voltage at which the plant must operate demanded a heavier field current than the rheostats were designed to carry. Very simple changes in the rheostats permitted them to be used for this sustained load.

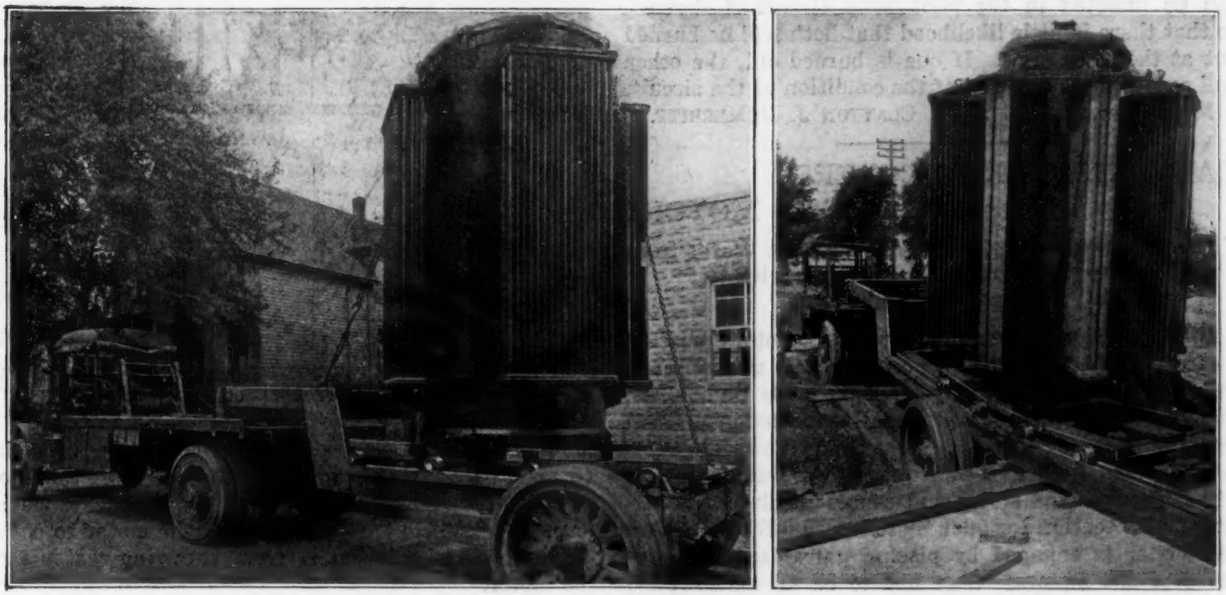
In the original rheostats, which had three sets of elements, the section which was in constant use was below the other two. This arrangement caused the top layers to be heated unnecessarily by the hot air arising from the bottom layer. In addition, the wiring ran above and between the grids and was subjected to more heat than the insulation could withstand. Copper washers used to compensate for the space occupied by the terminal rods oxidized to such an extent that they frequently fell apart and caused short circuits.

In order to keep the generators in service while the rating of the rheostats was increased, a spare field rheostat was constructed with improvements over the original type. All copper washers in the rheostats were replaced with iron washers and the grids were placed in two layers with the section in constant use at the top. The terminals were so arranged that all wiring would be placed on the outside of the rheostat, thus protecting it from heat.

The new spare rheostat was built from standard grids taken from discarded transformer neutral grounding stacks. This necessitated the purchase of only a circuit breaker.

Baltimore, Md. N. B. HIGGINS.

Trailer Used by Detroit Company Transporting a 2000-Kw. Transformer



The trailer is constructed of heavy steel plates and bars, the bed being hung low so as to facilitate handling heavy equipment. The load rests on a stout conveyor or trucks which is carried on small iron wheels as shown in the illustration. These wheels fit in a track formed of channel irons. When the truck is in motion, steel blocks are bolted to the track to prevent the wheels from rolling. Before unloading these blocks are removed and channel-bar extensions are hooked securely to the trailer.

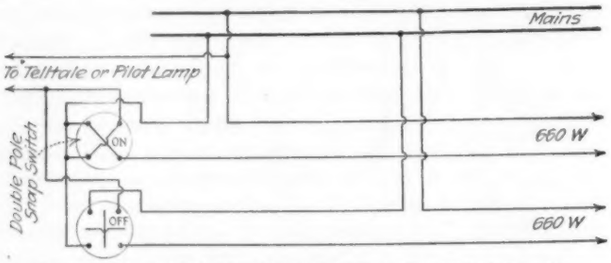
INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

PILOT LAMP INDICATES STATE OF PLANT CIRCUITS

Can Be Placed in Any Location, Independent of Lighting System, to Tell When Circuits Are Turned Off

It frequently happens that several lamp circuits have to be controlled from separate points. As a result some of the lamps may be left lighted unintentionally. Where this would be objectionable the pilot lamp scheme used at the Lane Manufacturing Company's plant in



METHOD OF CONNECTING CIRCUITS AND SWITCHES FOR PILOT-LAMP SYSTEM

Montpelier, Vt., may be used to advantage to indicate when all the lamps are not extinguished. Its system involves the use of relatively little wire and double-pole snap switches. The factory circuits are connected to one-half of the contacts of these double-pole switches and the other contacts of the switches are connected in multiple and are inserted in series with the pilot lamps. Thus when any circuit is "on" the pilot lamp will also be "on"; if the circuits are all dead, the non-lighting of the pilot lamp will indicate this condition. Two lamps can be inserted in the pilot lamp circuit if desired, so that there is little likelihood that both will be burned out at the same time. If one is burned out, the other will assure the indication of the condition of the circuit.

Montpelier, Vt. CLAYTON J. DEMERRITT.

GALVANIZED-IRON COVERS FOR PROTECTING MOTORS

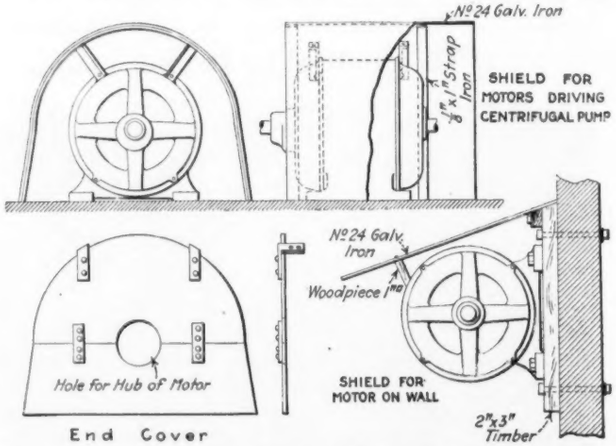
Three Types Used in Paper Mill Prevent Water from Getting Into Motor Windings with Subsequent Failures

In the pulp and paper industry many motors must be placed in wet and damp positions, as under tanks to drive centrifugal pumps, because the pumps are more efficient when the material to be pumped flows into the tanks by gravity. Sometimes, however, these overflow and drench the motor with water or liquor, which grounds the motor and causes insulation breakdown. Protection for such motors was afforded where the writer is engaged by placing galvanized-iron covers over the motors. Care had to be taken, however, to leave an air space of at least 8 in. (20 cm.) between the top of the motor and the cover for ventilation.

One type of cover was made as follows: Two pieces of ⅛-in. by 1-in. (3.2-mm. by 2.5-cm.) strap iron, which form the contour of the shield, were placed the length of the motor apart and riveted to the No. 24 galvanized iron sheet. The shield was attached to four angle-iron pieces which are arranged and fastened as shown. To prevent the priming liquid from injuring the motor an end covering was fastened to the top shield on the side nearest the pump by means of angle-iron pieces and stove bolts. The opposite end of the motor was left open, but the hood extends beyond the motor's end about 8 in. (20 cm.). Leaving the front open provides adequate ventilation for the motor.

To protect motors from occasional splashes of water and from heavy dust a self-supporting hood was used in some cases, but this rests on the floor and is not supported by the motor. Three pieces of ¼-in. by 1-in. (6-mm. by 2.5-cm.) strap iron were used here to stiffen the hood, the third strap being placed in the center of the sheet iron. The shield is then simply placed over the motor to be protected so that there is about 6 in. (15 cm.) clearance above the motor to provide ventilation.

The shield shown in Fig. 2 is used to protect motors that are mounted on the wall. It consists of a sheet of No. 24 galvanized iron large enough to cover the motor. A piece of wood 2 in. by 3 in. (5 cm. by 7.5 cm.) fastened to the covering is nailed to the wooden frame above the motor. To prevent the hood from



FIGS. 1 AND 2—HOODS FOR PROTECTING MOTORS DRIVING CENTRIFUGAL PUMPS AND FOR SHIELDING WALL MOTORS

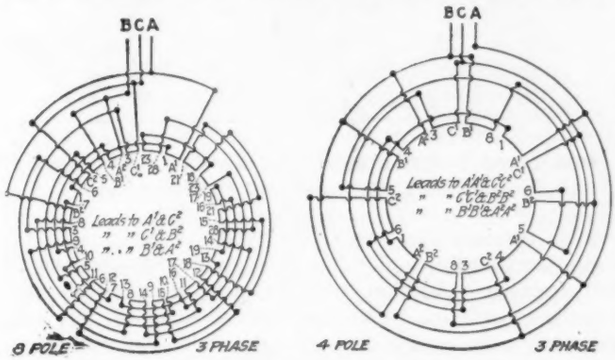
touching the motor a piece of wood 1 in. by 1 in. (2.5 cm. by 2.5 cm.) is nailed to the center of the hood so it will rest on the motor. This hood extends at least 1 ft. (30 cm.) on each side of the motor to cover the pulley and prevent it from throwing water into the motor.

Aroostook Pulp and Paper Mill. W. B. SMITH.
Van Buren, Me.

CHANGING THE SPEED OF AN INDUCTION MOTOR

When Speed Had to Be Doubled It Was Found Desirable Also to Double Rating, as Mechanical Qualities Were Adequate.

Instead of purchasing a new motor of increased speed when the speed of a certain machine was to be doubled, an industrial concern decided to rewind the original motor to fit the new operating requirements. The motor was a 5-hp., 440-volt, three-phase, 60-cycle, 900-r.p.m.



FIGS. 1 AND 2—STATOR WINDING OF SQUIRREL-CAGE INDUCTION MOTOR BEFORE AND AFTER SPEED WAS DOUBLED

synchronous speed), eight-pole squirrel-cage induction motor, and it was rewound for 440-volt, three-phase, 60-cycle, 1800-r.p.m. (synchronous speed) with four poles. The change was made as follows:

The eight-pole winding consisted of forty-eight coils (two-layer winding) of thirty-two turns of one No. 16 (0.0508 in.) double-cotton-covered wire per coil, connected series-delta (Fig. 1). There were sixteen groups with two coils in series per group, and the pitch of the coil was one and seven, which is full pitch, or 100 per cent chord factor for eight poles.

As the required speed (1800 r.p.m.) was double the original speed, the rating of the motor was increased to 10 hp. in order to retain the same torque. The rotor, bearings, shaft, etc., were found of adequate size to stand the added mechanical strains due to the higher speed, and, being found satisfactory, the winding was developed.

If the motor is considered as a generator, with the speed doubled it would develop twice the voltage, and therefore, if the motor was rewound with the same number of turns and connected series-delta, it would require a line voltage of 880 for the 1800 r.p.m.

As the machine was to be rewound for 440 volts, the number of turns could be reduced one-half and the area of copper increased in the same proportion and the winding connected series-delta. However, this would make a stiff coil, which would be difficult to handle. As the full pitch of the four-pole winding should be 48 divided by 4 or 1, and 13, the coil ends would project beyond the iron further than the eight-pole coil ends did, because the pitch of the new coil is longer. Developing a coil for the 1 and 13 throw, it was found that the coil ends extended out so far as to interfere with the end brackets, and the pitch was therefore decreased one slot at a time, until a throw was obtained that would leave at least ½ in. (13 mm.) clearance between the end brackets and the coil ends on each side of the machine. The correct pitch was found to be 1 and 10. Now, as decreasing the pitch or chording would have the same effect as reducing the number of turns in the coil, in the proportion of 1—the sine of one-half the electrical angle included between both sides of the coil—the angle for the 1 and 10 pitch would be 135 deg. The sine of one-half this angle is 0.92388, and the active turns will be decreased $1 - 0.92388 = 0.07612$, or 7.612 per cent. This decrease would cause the motor to act as if overloaded 7.612 per cent. Now, as the motor was for continuance duty and as there was ample room in the slots for the needed turns, it was thought advisable to increase the turns 7.612 per cent. The new coil would then have thirty-two times $1.07612 = 34.43584$, or thirty-four turns of one No. 16 0.0508-in. double cotton-covered wire per coil. The stator was then rewound with forty-eight coils of thirty-four turns each with a pitch of 1 and 10, connected parallel-delta (Fig. 2). There were twelve groups of four coils in series per group. The rotor bars were then welded to the end rings, and the end rings were turned down to increase the resistance, as welding a rotor tends to decrease its resistance.

The motor was assembled, given a load test, and was found satisfactory in every respect.

New York, N. Y. C. A. JOHNSON.

TEST RESULTS TABULATED ON FACTORY MOTOR CARD

Comparison of Records Bearing Motor Ratings and Characteristics Allows a Complete Analysis of Power Conditions in Plant

When making a complete power survey of the installed motors in its plant, the Robbins & Myers Company recorded the results of the test on 5-in. by 8-in. (12.5-cm. by 20-cm.) filing cards. These cards are provided with spaces for shop serial and frame number, the name-plate data, the department, data on driving and driven pulleys, size of belt, machinery driven, and the load readings of the motors. In addition to this information there is a space for the specifications

FACTORY MOTOR RECORD

Date_____

Shop Number_____ Serial_____ Frame_____ H.P._____

Volts_____ Amps_____ Spec._____ Dep't_____

Rated Speed_____ Actual Speed_____

Driving Pulley_____ Driven Pulley_____ Belt Width_____

Description of Drive, Machinery Driven, etc.:

Load_____ K.W. Amps._____ R.P._____ Volts_____ H.P._____

FACTORY MOTOR CARD SHOWS RESULTS OF MOTOR TESTS

which are necessary in order to permit a complete analysis of the motors. Of course it would be impossible for every plant to have performance curves of all its motors, but in this case it is possible because practically all motors are manufactured in the plant. There is therefore available a complete file of these curves and with the data gathered from the test each motor's performance can be analyzed. This analysis allows the determination of whether or not it is economical, to make changes and what changes are necessary. Motors are provided that will operate at

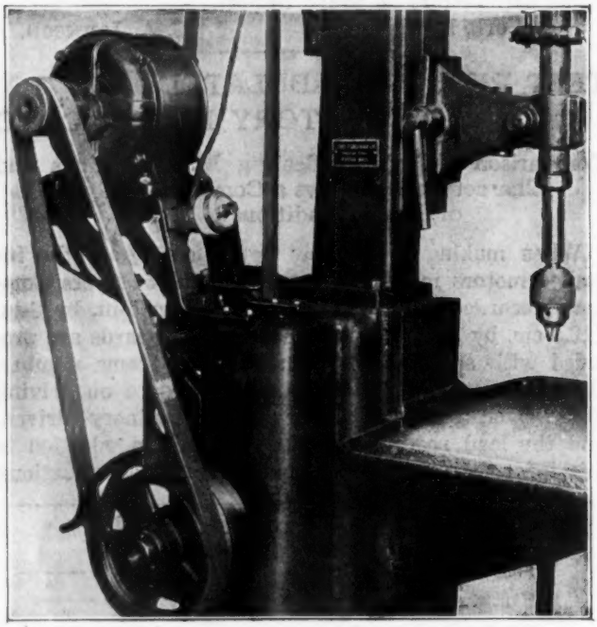
the highest efficiency and power factor on the determined load, but often it is necessary to take future extensions into account.

R. F. MCNETT,
Springfield, Ohio, Supervisor of Power.

HOME-MADE MOUNTING FOR DIRECT-BELTED MOTOR

Space Limitations Prohibit Direct-Connection Drive—Switch Mounted on Floor or Wall Within Easy Reach of Operator

To drive a 12-in. (30-cm.) Allen vertical drill at the factory of the Rawson Electrical Instrument Company, Cambridge, Mass., it was necessary to mount a ½-hp., 110-volt Westinghouse single-phase induction motor upon the machine frame. Space limitations made the installation difficult, but it was effected satisfactorily through the use of 1½-in. by $\frac{3}{16}$-in. (4-cm. by 5-mm.) iron straps bent to hold the motor about 12 in. (30 cm.) above the working plane and thus provide for satisfactory direct belting. Diagonal bracing below the skeleton



MOTOR MOUNTED ON MACHINE FRAME ABOVE DRIVEN PULLEY

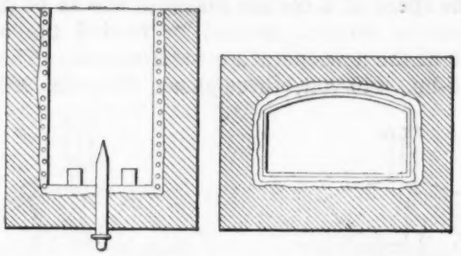
bracket thus formed for the motor stiffens the frame. The motor-control switch is conveniently mounted on a 1-in. by ¼-in. (2.5-cm. by 6-mm.) supporting strap within easy reach of the operator at the drill.

ADVANTAGES OF CYLINDRICAL HEAT-TREATING FURNACE

Discussion of Its Merits as Compared with Those of the Other Wire-Wound Furnace, Namely the Hearth-Muffle Type

There are two general types of wire-wound electric heat-treating furnaces which are used to quite a large extent for relatively small work. One type may be called the cylindrical or "pot" type and the other the ordinary hearth-muffle type. In the ordinary hearth-muffle furnaces the work usually rests on the hearth, while in the cylindrical furnaces the work is usually suspended on jigs or by wires. When the product being treated requires the utmost care as to rate of heating and uniformity of temperature, the cylindrical type of electric furnace has an advantage over the ordinary hearth-muffle furnace in the method of placing the work in the furnace, according to A. F. MacFarland, of the U. S. Ball-Bearing Company.

The work in the hearth-muffle furnace resting on the



FIGS. 1 AND 2—CYLINDRICAL AND HEARTH-MUFFLE TYPE ELECTRIC HEAT-TREATING FURNACES

hearth receives heat from the walls of the muffle by radiation and by conduction through the atmosphere of the furnace. Another advantage is the facility for handling material in the cylindrical furnaces on jigs. Of course there are special cases where the hearth-muffle type of furnace may have an advantage over other types, and the above statements apply in general only.

COST COMPARISONS FOR MOTION-PICTURE PROJECTION

Energy and Maintenance Costs for an Installation of Gas-Filled Tungsten and Arc Lamps Are Tabulated, Showing Total Saving

The economy for motion-picture projection of gas-filled tungsten lamps over arc lamps is clearly shown in the accompanying table compiled by George G. Cousins of the Hydro-Electric Power Commission laboratories. In addition to the economical advantage of incandescent lamps, further considerations are responsible for their selection. Among these are the elimination of light fluctuation and eye fatigue, reduction of wear on machine due to absence of carbon ash, less heat in the operating booth and simpler control. Although high screen brightness is not obtainable by the use of incandescent lamps, it is thought that some values of screen brightness now used are higher than necessary.

COMPARISON OF COSTS OF ARC AND MAZDA LAMP PROJECTION

Type of arc.	Type of arc control.	Renewal cost of carbons per 10-hr. period.	Renewal cost of Mazda lamps at $6 ea. giving 100 hrs. life.	Additional cost of Mazda renewals over carbon renewals per 10-hr. period.	Cost of energy per 10-hr. period for arc at 6c. per k.w.-h.	Cost of energy per 10-hr. period for Mazda lamp.	Saving in cost of energy for 10-hr. period for Mazda over arc.	Total saving per 10-hr. period over arc with Mazda at 100 hrs. life.
35-50 amp. a. c. or d. c.	Rheostat	$0.30	$0.60	$0.30	$2.76	$0.51	$2.25	$1.95
35-50 amp. a. c.	Compensator	0.03	0.60	0.30	1.42	0.51	0.91	0.61
35-50 amp. d. c.	Motor-generator	0.30	0.06	0.30	1.29	0.51	0.78	0.48
60-75 amp. a.c. or d.c.	Compensator	0.39	0.60	0.21	2.24	0.51	1.73	1.41
60-75 amp. d. c.	Motor-generator	0.37	0.60	0.23	2.04	0.51	1.53	1.30

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics. Including Methods of Increasing the Use of Electric Light, Power and Heat

EMPLOYMENT OF OIL AS FUEL FOR CENTRAL STATIONS

Difficulties of Transportation, General Points of Advantage, Importance of Facilities for Storage and Cost Are Factors in Every Application

The remarkable increase in oil production was recently demonstrated in papers by Henry Thomas and E. H. Peabody, before the American Heating and Ventilating Society and the American Society of Mechanical Engineers, by a comparison of the oil production in 1859 of about 2000 barrels per annum in the United States with that of the world production in 1918 of about 500 millions of barrels per annum. The world production in 1918 was distributed with about 355 million barrels in the United States, about 63 million barrels in Mexico, about 40 million barrels in Russia and the remainder scattered. These figures show the Mexican production to be about 15 per cent of the world production.

Of the total of 355 million barrels of oil produced in the United States per annum it is estimated that from 75 to 150 million barrels are used annually for fuel purposes. As far as the Eastern States are concerned, the Mexican oil fields must be depended upon for the oil supply for fuel uses. It is interesting to note that other oil fields not yet developed in Mexico promise to yield an output of oil as great as the present Mexican supply.

The greatest difficulty at this time in the use of oil as a fuel lies in the transportation problem. With an estimated coal shortage in 1919 of say 100 million tons, there is little need for further reason why the oil supply does not meet the demand. The fact that about 100 million gallons of gasoline are required per annum for automobiles is an evidence of the magnitude of the demands upon the oil industry at the present time.

Among the principal advantages of oil for power plant boilers there may be mentioned the following: Higher efficiency for boiler and furnace; flexible control at light loads; high average boiler capacity; low cost of banking fires; elimination of labor difficulties; repairs less costly; low cost of handling fuel; uniform grade of fuel; general cleanliness and quick starting of fires.

The facilities for oil storage are obviously one of the very important items to receive consideration in the oil-burning plant. Where these facilities amount to say ten to twenty thousand gallons, horizontal storage tanks are often used, but for larger storage facilities vertical tanks are preferable. While the idea is often advanced that many small hand-fired power plants could be given a higher efficiency by changing over to oil burning, it should always be remembered that oil by its very nature is a zone proposition.

The viewpoints of producer and consumer of oil are apparently very similar, but while almost any one can consume or burn oil, the refinements in most cases require expert assistance, and while the consumer of oil usually appreciates the advantages outlined above for oil, two points always must be faced, namely, can oil be secured in sufficient quantity, and how much will oil cost as a fuel in comparison with coal? Practically every case is a special problem of its own, and it is very difficult to give general rules which will cover all cases. Each problem should be worked out on a basis of the cost of oil and coal together with the numerous other economic items which enter into the solution.

WISCONSIN CONFERENCE ON AGRICULTURAL SERVICE

Analysis of Present Practices with Enumeration of Advantages and Disadvantages of Different Plans of Handling Business

By C. D. LeCheverell
Secretary Railroad Commission of Wisconsin

Utilities and others interested in rural electric service recently held a conference with the Railroad Commission of Wisconsin to discuss questions of rural extensions and use of electricity by the farmers which have come to the fore very rapidly in the last two years, due, no doubt, to the unprecedented prosperity of the agricultural districts. This demand for service came at a time when all utilities were suffering from the financial stringency and were practically unable to secure capital to make needed extensions. It was recognized and was admitted by all utility operators that the most satisfactory method of extending this service would be to have the work done at the expense of the utility. Practical considerations at the present time make this out of the question. Two methods have been followed in Wisconsin. The utility has made the extension where the cost of it has been borne by the farmers to be served. The result of this method has been that the farmers, say, on a line extending east from the utility would receive service at an initial expense of $250 each, while the farmers residing, say, west of the utility would be obliged to pay $350 to $400 each, due to the fact that their district was more sparsely settled than the district the other side of town. Another serious objection has been that there would be twelve possible customers on the proposed line, nine of whom would contribute to the cost of its building. The other three farmers, although refusing to contribute to the initial cost of the line, would demand in many cases and would be able to force the utility to give them service since the utility is a public service corporation and has facilities for serving such farmers, its lines passing alongside their farms.

In selling energy to rural customers, if the expense of constructing the line has been borne by such customers, the utility has usually put into effect the urban

rate modified in some instances by a higher minimum monthly charge.

The other method which has been followed to considerable extent in Wisconsin has been for the farmers in a certain district wishing to receive electrical service to incorporate as a distributing company, the prospective consumers taking stock enough to cover the cost of building the proposed line. This distributing utility purchases its energy at a wholesale rate at the city limits, and in turn bills it to its customers at a higher rate—a higher rate planned to include the ordinary distribution and operating expenses of the farmers' utility. This has resulted in farmers usually paying a higher rate than was charged by the local utility in the city and has also been open to the objection that certain farmers would refuse to become stockholders and yet demand and be entitled to receive service from the company.

The utility operators who were present at the conference were quite unanimous in their opinion that the present rates for rural electric service in effect are unremunerative and in fact throw a burden upon the urban consumers of making up the deficit arising from the operation of the rural business. The representatives of the farmers and consumers who were present and the representatives of the farmers' distributing companies who were present agreed that the rates for rural business ought to be compensatory, and that no burden should be thrown on the urban customers by reason of rural service. The rural companies that have been formed aim in their rates to cover merely operation and provide no return on the investment. It was pointed out that if the rate were made sufficiently high to cover a return on the investment, they would then be able to sell their stock on an investment basis and could offer service on an equal basis to all prospective customers who apply, whether stockholders or not. One suggestion was made that in both cases the utility should establish a consumer charge which should be equal to the interest charge upon the investment per consumer, and that, where the consumer was a stockholder, or where the consumer had contributed his proportion of the expense of constructing the line, this consumer charge should be waived. It was claimed that this would place the non-stockholder and the farmer who refused to contribute to the cost of building the line on the same basis with stockholders and those who did contribute.

All of these plans have ignored those elements of the excess cost of rural service over urban service such as increased depreciation per customer, increased maintenance per customer, increased line losses due to the fact that there are fewer customers per mile of line, increased transformer loss due to fewer customers per transformer and the increased maintenance expense.

It was agreed when the meeting adjourned that those present should formulate their experience and views and submit them to the commission, who would then make a study of the matter presented and, if feasible, have printed in pamphlet form a summary of this information together with such recommendations or proposals as the commission might deem advisable. In calling this conference it was not the commission's idea that it would be able to put into effect any hard and fast rule governing rural extensions. It was thought, however, that principles might be laid down.

ELECTRIC REFRIGERATORS ARE REVENUE PRODUCERS

This Profitable Field for Residential Lines Should Be Developed—Figures on Monthly Revenues from Installations

That the domestic electrically operated refrigerator is a most profitable producer of revenue is the opinion of sales managers of four power companies in cities in Ohio who were interviewed on this subject. Some of the managers state that this device has no equal as a revenue producer on residential lines and that the field has immeasurable possibilities. The following table shows the approximate revenues which these machines are producing as far as data are available:

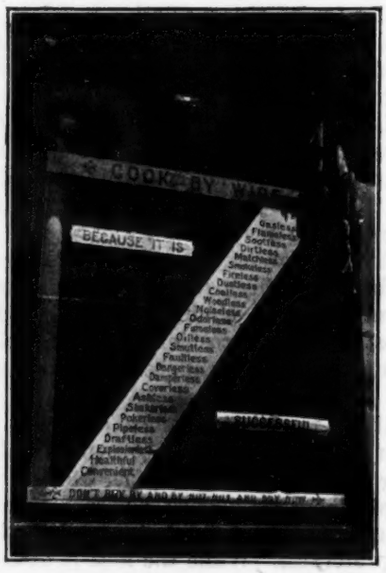
Demand Each	Kilowatt Hours per Month	Monthly Revenue
400 watts	100 to 125	$5.00 to $6.25
	50 to 60	2.50 to 3.00
	75 to 90	3.75 to 4.50
	60	3.00

These figures are not higher than the amount the average family pays for ice. Besides, the companies state that the dry, even temperature prevents food molding and spoiling. One company states that in one of these refrigerators food was kept five and six days without spoiling and milk was kept sixteen days.

All companies emphasized the importance of proper installation and the use of a good ice box in order to keep down excessive costs to the consumer. Besides this only an occasional oiling and adjustment by a service man were deemed advisable.

The companies interviewed were: Toledo Railways & Light Company, Lorain County Electric Company, Elyria; Trumbull Public Service Company, Warren, and Alliance Gas & Power Company.

Effective Central-Station Range Advertisement Used by Maine Company



The Central Maine Power Company recently "ran" an unusually effective electric range window advertisement, illustrated herewith, in which no less than twenty-seven advantages of electric cooking were featured on a diagonal poster connecting a "Cook by wire" invitation with the admonition "Don't buy by and by, but buy and buy now." The display attracted widespread local attention.

POLITIC WAY OF INTRODUCING AUTOMATIC RATE ADJUSTMENTS

Discount Given to Power Customers Who Sign Rider Which Varies Rate Schedule with Changes in the Company's Cost of Coal and Labor

On the theory that it is better public policy to say "Will you?" than "You must," one of the large central stations in the Middle West gives a discount of 0.25 cent per kilowatt-hour to all power customers who sign its standard rider providing for automatic adjustment of the rate schedules. This method has proved so successful that practically all the company's power customers who require 50 kw. or more have agreed to pay rates which shall be automatically adjusted to compensate for changes in the cost of supplying the service. These adjustments in the power rate schedules are made on the following basis:

"When the cost of heat units in the coal delivered into the company's bunkers is greater or less than 14.5 cents per 1,000,000 B.t.u. (252,000 cal.) the rate charged for electric energy shall be increased or decreased at the rate of 0.045 cent per kilowatt-hour for each increase or decrease of one cent or major fraction thereof above or below 14.5 cents per 1,000,000 B.t.u. (252,000 cal.).

"When the equivalent hourly wage of all employees (excluding department heads and officers) is greater or less than 58 cents the rate charged for electric energy shall be increased or decreased at the rate of 0.012 cent per kilowatt-hour for each increase or decrease of one cent or major fraction thereof in the equivalent hourly wage."

The company makes provision for obtaining all necessary tests and records each month. The unit cost of heat units and the equivalent hourly wage obtained from these records constitutes the basis for adjusting charges for energy on bills rendered during the thirty-day period beginning with the tenth day of the succeeding month. This allows ten days after the end of any thirty-day period for compiling the records.

VALUE OF PROMPT-PAYMENT DISCOUNTS IS QUESTIONED

Relations with Large Power Customers Disturbed by Existence of Net and Gross Charges—A Comment from New England

The time-honored practice of billing electrical energy at a certain net rate provided payment is made within a stated period after the statement is presented has been in vogue among central stations so long that it has become an institution. A recent experience of a New England company with this arrangement, however, has convinced the management that the establishment of a standard rate per kilowatt-hour payable within thirty days is preferable to the discount plan. The use of the net rate worked out well enough when dealing with residential lighting customers and small power users, but in two late cases its application has created serious annoyance in dealing with large industrial customers.

One of these customers purchases energy amounting to $3,000 per month and ordinarily makes payment within the time limit necessary to secure the 10 per cent discount. Recently the time expired without payment, owing to illness in the customer's clerical force. The office system should have taken care of the matter automatically, and it was obviously no fault of the central station that the bill was delayed in payment. Nevertheless, the industrial plant was obliged to pay $300 more for energy in the month in question than would have been the case had the usual prompt payment of the central station bill occurred, and the bill was finally settled only after considerable discussion had taken place, in which the central station manager stated that if he rebated the excess above the net he would become liable to the public utilities commission for practicing discrimination.

In the other case, a valued power customer refused to pay the gross rate although the time limit on the discount had expired, and at last accounts the central station had no recourse except to notify the customer that unless full settlement were made service would have to be cut off. In discussing these cases with a representative of the ELECTRICAL WORLD, the manager stated that he was convinced that the friction arising from the existence of the discount between the central station and the large customers made it expedient to eliminate the gross rate, and he proposed at an early date to establish net rates applicable to the various classes of customers and subject to thirty-day payment.

Diplomatic Forecast of Probable Rate Change

KOKOMO—

NOT A WAY STATION BUT A DESTINATION.

Kokomo's Fifth Annual Industrial Exposition is ample manifestation.

Thrifty and forward looking communities need substantial and capable public utilities.

The public generally is learning to appreciate more and more the value of efficient central station service as an important city building enterprise.

Our purpose is to keep our organization large enough in management and equipment to attend all demands so long as said demands are consistent with our ability to collect equitable compensation.

We would have you remember that the HIGH COST OF LIVING OF THE PUBLIC UTILITY is as disastrous to its financial resources as it is to those of a salaried individual whose income is likewise fixed.

Unless rates are sufficient to attract a ready supply of fresh capital for utility extentions and improvements, public interest suffers; for without such an influx of funds service is bound to deteriorate and capital will be diverted to other activities which are more profitable but less important to public needs.

Therefore, the public owes it to themselves as progressive citizens of a progressive community to see to it that its public utilities are properly fed and clothed—in order that community growth may not be impaired and honest investments destroyed.

COURTEOUS, CONTINUOUS SERVICE

Indiana Railways and Light Company.

The advertisement which is reproduced with this article was used recently in special local editions of Kokomo, (Ind.) papers issued in connection with the city's industrial exposition week. It aimed to accomplish a twofold purpose. It expressed the Indiana Railway & Light Company's good faith and public spirit toward its community, and it intimated rather pointedly yet tactfully that the general public utility situation demanding higher rates might soon find application in Kokomo.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Interchangeability of Squirrel-Cage Rotors.—B. B. RAMEY.—In case of injury to the rotor or squirrel-cage induction motor it often happens that a star rotor of the particular motor in trouble is not available. The writer shows that in such emergencies it is sometimes possible to use rotors of other ratings that may be on hand provided they fit mechanically.—*Electric Journal*, November, 1919.

Wide-Range Speed Regulation of Direct-Current Motors.—G. BARRUSTA.—It is often desirable, for instance in paper mills, to cover a very large range of speed by continuous regulation on the driving motor, such that the torque decreases as the speed goes up. A range of at most one to four can be had by adjusting the motor field at constant voltage. Speed regulation may also be obtained at a constant motor excitation by employing a separately excited generator to supply the motor voltage, the adjustment being made in the generator field. In the first case the motor runs with poor commutation at high speeds, in the other case the generator commutation will be difficult at low motor speed. The author proposes to combine the two methods, using motor field regulation at lower speeds and generator field regulation at higher speed. The question of efficiency is considered, it being shown that while armature copper loss should be kept low, high maximum values of magnetic induction are permissible.—*L'Industrie Electrique*, Sept. 10, 1919.

Iron-Sickness in Transformers and Generators.—M. VIDMAR.—The author draws attention to the disastrous effects that may arise from iron filings when, through carelessness in construction, they exist in cavities in the iron cores of electrical machinery. In large units considerable voltages (of the order of a few tenths of a volt) may occur between neighboring plates or other parts. If iron filings, or chains of filings, bridge across such places, very high local temperatures may obtain through development of Joulean heat—0.2 volt would suffice to heat an iron particle to 1000 deg. C. inside a fraction of a second. A burn may result where the insulation between laminae is destroyed. The local losses then increase, and break-down follows in severe cases. In investigating certain cases of transformer burn-outs, the author found in the cores big lumps of solidified iron filings, forming welds across bundles of plates. This leads to the conclusion that iron-sickness was the cause of these premature break-downs. The accumulation of material around the burn, and the welding of the plates, may go on for weeks, and results in a steady increase of the no-load losses, manifested by a slow rise in oil temperature. As preventive means there are suggested subdivision of the core by heavy pressboard insulations for every thirtieth plate, and use of paper with projecting edges.—*Elektrotechnik und Maschinenbau*, Jan. 5 and 12, 1919.

Lamps and Lighting

Factory Lighting a Central-Station Problem.—O. R. HOGUE and J. J. KIRK.—Analyzing the data collected by the Commonwealth Edison Company during the past year, a marked tendency is shown toward higher intensities of artificial lighting. It is said that the average intensities in the larger new installations during the past year have been more than double those five years ago. Very little local lighting is used and that only when necessary. It is also shown that during the winter months which have the greatest amount of darkness the average watts per unit installed are higher than during the other months of the year. The figures in the table show the advantage obtained by increasing from the ordinary low standard to a moderate intensity and also the still further advantage of increasing to a real production intensity. It seems certain that in promoting productive intensities there appears the greatest possibility of service to industry, and wide adoption of such intensities is only a matter of getting the truth before the responsible executives.—Paper read before Illuminating Engineering Society, Oct. 23, 1919.

OLD INSTALLATION

Class of Business	Equipment	Watts per Sq.Ft.	Foot-candles
Iron-pulley-finishing shop	Drop cords, 60-watt lamps, bare or tin shaded	0.27	0.2
Soft-metal-bearing machine shop	25 100-B deep-bowl reflectors.	1.00	4.6
Heavy-steel machine shop	13 100-watt C, 23-in. eye-shield units	0.60	3.0
Carburetor assembling shop.	84 40-watt B, two 100-watt C, 14 40-watt drops	1.00	2.1

NEW INSTALLATION

Equipment	Watts per Sq.Ft.	Foot-Candles	Average Increase in per Cent Production	Total Cost in per Cent of Payrol
200-watt C reflectocap units	1.90	4.8	20	5.5
25 200-watt C deep-bowl reflectors	2.00	12.7	15	...
13 300-watt C in same units	1.70	11.7	10	1.2
19 300-watt C, 10 200-watt C eye-shield units	1.90	12.5	12	0.9

Photometry of Searchlights.—The nearest point to a searchlight at which the photometric law holds depends on the size of the source of light, the focal length and the diameter of the mirror. This limiting distance can be calculated or determined by experiment, but it is not correct to assume that it is 500 times the focal length, as is often done. Besides measuring the maximum intensity of the beam, the distribution of the light within the beam should be determined by rotating the searchlight so that the beam passes across the photometer head, particular care being taken that the exact center of the beam passes the photometer. The absorption of light in fairly clear air is about 10 per cent for 1 km. distance and 20 per cent in air of poor transparency. The effect of absorption may be eliminated from the test by taking photometric measurements at two different points sufficiently far apart, but this

may lead to great errors in the case of unsteady searchlights. It is preferable to take the two observations simultaneously with two photometers at points subtending a small angle at the searchlight and at equal heights above the ground.—*Technical Review*, Oct. 14. (Abstracted from *Electrotechnische Zeitschrift*, July 31, 1919.)

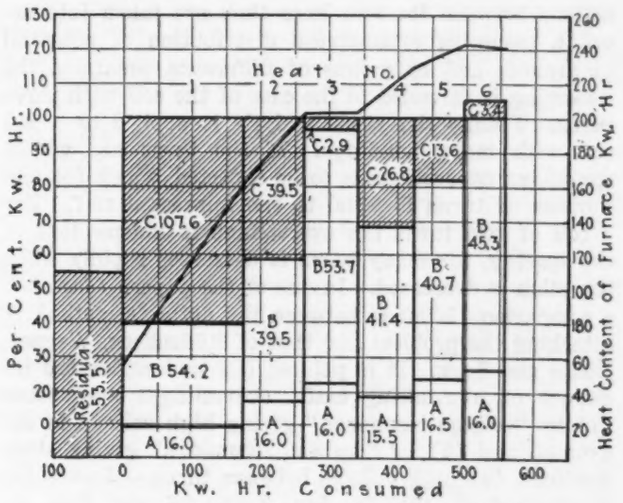
Generation, Transmission and Distribution

The Blomquist Steam Generator.—A steam boiler, or high-speed steam generator, of a radically new type, has been put in operation in a Gothenburg mill. The boiler consists of 11 pressed steel cylinders of 305 mm. (12 in.) diameter and 2.5 m. (8 ft.) heated length, which are rotated at the rate of 375 r.p.m. Due to centrifugal action the water will cover the entire inner surface of the tubes, keeping the temperature of the steel below 300 deg. C. The tubes are supported in ball bearings, feed-water being injected at one end and steam taken out at the other, through steam-tight boxes. The generator produces 6000 kg. (13,000 lb.) steam per hour, at 50 atm. (740 lb. per sq.in.). The heated surface is 27 sq.m. (290 sq.ft.), which corresponds to a normal vaporization of not less than 220 kg. steam per sq.m. (45 lb. per sq.ft.) per hour. This steam generator may be used to increase the pressure in existing plants, where high-pressure turbines can be employed to utilize the increase in boiler capacity thereby obtained.—*Elektroteknisk Tidsshrift*, June 20, 1919.

Installations, Systems and Appliances

Developments in Lifting Magnet Practice.—F. N. PICKETT.—The lifting magnet has proved to be one of the most efficient devices in the saving of time and labor where iron is handled in large quantities. In the present article the use of this implement is described in various applications, including the handling of pig iron, steel rails and plate. Interesting problems arise in adapting the lifting magnet to these various purposes, and these are dealt with in the article.—London *Electrician*, Sept. 26, 1919.

Commercial Testing of Metallurgical Electric Furnaces.—H. M. ST. JOHN.—The electric furnace test proper naturally resolves itself into three parts—the preliminary test, the intensive test and the operating test. These must sometimes be supplemented by various special tests to determine some one factor which cannot readily be studied under ordinary operating conditions. The preliminary test covers the period from the time current is first turned on until the furnace is operating smoothly under regular plant conditions. This period will ordinarily include from one to two weeks, although it may be much more prolonged. The object of the intensive test is to determine the best possible performance of which the furnace is capable under the stipulated manufacturing conditions. A careful determination is made of all the factors which enter into the reliability and economy of furnace operation. When the intensive test has been completed, unless the furnace has already exhibited defects so serious as to make its further use undesirable, it should be put to work as a regular part of the plant equipment and operated steadily in a routine manner for at least a month. The figure shows a diagram of one day's operation, in which the percentage of total energy input, as utilized and dissipated in various ways, is plotted against the total input expressed in kilowatt-hours. *A* represents the heat absorbed by the metal, calculated as 160 kw.-hr. per ton of brass at 1090 deg. C. (1994 deg. Fahr.); *B* the various heat losses from the furnace during operation, and *C* the heat absorbed by the furnace structure as its temperature rises. In each of the rectangles shown in the diagram the altitude indicates the percentage of heat input disposed of in the manner indicated, while its area is proportional to the heat input in kilowatt-hours. In rectangles marked *A* the altitude represents also the thermal efficiency of the furnace during each heat. The shaded areas indicate that heat energy stored in the walls of the furnace, that marked "residual" being the initial stored heat with which the furnace started the day. The figures show the numerical values



HEAT BALANCE OF A RESISTANCE FURNACE

of each area in kilowatt-hours. The broken-line curve indicates the rate at which heat is being stored by the furnace, or—what is virtually the same thing—the rate of temperature rise.—*Chemical and Metallurgical Engineering*, Sept. 15, 1919.

The Elimination of Dust from Gases by Electricity.—The latest improvements in this process provide for the filtration of the gases in a powerful electric field. Very high-tension electricity is needed, so the alternating current generated at 110 volts and 25 periods is transformed up to 50,000 volts. This high-tension current is then rectified by "kenotrons," which are a sort of valve with very low vacuum and incandescent cathode described later. The actual dust filters are composed of metal tubes of ordinary commercial sizes, inside which thread-shaped electrodes are maintained at high tension. The tubes may be placed either vertically or horizontally, and the arrangements differ according to the precise purpose in view. The p.. .icles of talc, cement, stone dust and metallic oxides can all be deposited. The dust of pyrites is deposited at a temperature of about 400 deg. C., and also the vesicles of the sulphuric acid to form the concentrated liquid. The "kenotrons" are static apparatus which resemble X-ray tubes in appearance, and they effect the same result as the rotary rectifiers generally employed. The volume of rectified current through the kenetrons increases rapidly with the temperature of the heated electrode and remains constant so long as the temperature of the latter is constant.—*Technical Review*, Oct. 28. (Abstracted from *La Technique Moderne*, August, 1919.)

Electrophysics and Magnetism

Voltage Surges in Coils.—W. ROGOWSKI.—In an extensive series of articles on the theory of propagation of electromagnetic waves in coils and the related practical questions of over-voltages in transformers and the protective action of choking coils, the author makes an attempt to predict theoretically the wave form of the voltage surge that penetrates into the winding, when an emf. is suddenly applied at the two ends of the coil. A solution is approached step-wise by considering first a coil of one turn, which is compared to a short-circuited line, then a coil of two turns, treated as a superposition of two lines with certain short circuits between them. The static and magnetic interactions between the two lines thus are taken into account, assuming symmetrical distribution of potential to ground, and by means of difference equations the reasoning is extended to the case of the coil with three turns. Finally the same analysis is applied to a flat coil with many windings. If the turns are widely spread, an overvoltage is to be expected, which for any number of turns is equal to the impressed emf. For a coil of two turns the overvoltage is independent of the spacing, for many turns it decreases rapidly when the pitch is decreased. In one of the papers (Jan. 26) a comparison is made between the author's method of attacking the problem and that of Rüdenberg, Wegner, Böhm and Lenz. It is pointed out that under the influence of alternating emfs. overvoltages may occur (1) by "voltage resonance," giving high voltage to the ground, and (2) by "current resonance," giving steep gradient, *i.e.*, high voltage between turns.—*Archiv für Elektrotechnik,* 1917-18, Jan. 8 and 26, and Feb. 17, 1919.

Electrochemistry and Batteries

Effect of Amalgamation Upon the Single Potential of Aluminum.—LOUIS KAHLENBERG and JOHN A. MONTGOMERY.—Measuring the single potential of aluminum in a one-third molar solution of aluminum chloride at room temperature by means of the calomel electrode, the writers obtained much higher values with amalgamated than with unamalgamated aluminum, owing to the removal of the coat of resistant oxide by the mercury. They showed also that the measurements were actually the single potentials of the aluminum and not those of an aluminum amalgam.—*Proceedings A. E. S.,* Sept. 23, 1919.

A New Lead Accumulator Theory.—CH. FÉRY.—Years of experimental research have led the author to the conclusion that the current theory of the phenomena of charge and discharge can no longer be upheld. Instead of the classical double sulphatation formula the following equation is given:

$$Pb_2 + H_2SO_4 + Pb_2O_5 = Pb_2SO_4 + H_2O + 2PbO_2.$$

Thus during the normal functioning of the cell no lead sulphate is ever formed. Instead a sulphate of univalent lead is supposed to form on the negative plates during discharge. This is an unstable salt of black color. In presence of sulphuric acid it easily changes into the ordinary white sulphate, which explains the turning white of the negatives through sulphatation when a battery is allowed to stand discharged. The action of the cell during discharge is compared to that of a primary battery, the polarization, by formation of hydrogen on the negatives, being prevented by the presence of lead pentoxide, which easily reduces to PbO_2, and thus acts as a strong oxidizing agent. The hypothetical subsulphate as well as the pentoxide are relatively good conductors, and the results of the author's quantitative work seem well to justify the assumption of their existence.—*Bulletin de la Société Française des Electriciens,* February, 1919.

Units, Measurements and Instruments

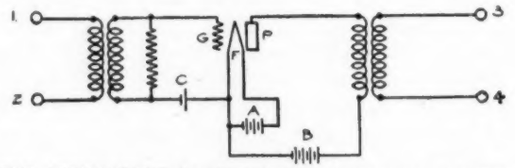
An Electric Distance Pressure Gage.—OTTO HAUSER.—On the pointer shaft of an ordinary manometer a small commutator is placed, so that it turns between two brushes. The commutator is so arranged that the resistance between the brushes will vary when the manometer deflects. This is utilized to actuate a pointer instrument, placed at some distance, *i.e.*, on a control panel, and built according to the ohmmeter principle, with two crossed coils, elliptic iron core, and without directive springs. A dry-cell battery of 3 to 6 volts supplies the control current. Graphically recording instruments are described, which are capable of tracing the pressure curves for up to 5 manometers on the same diagram, in rectangular co-ordinates and uniform scales.—*Helios,* Jan. 26, 1919.

A New Alternate-Current Potentiometer for Measurements on Telephone Circuits.—P. O. PEDERSEN.—A brief description of a new form of alternating-current potentiometer suitable for measurements of telephone circuits.—London *Electrician,* Nov. 7, 1919.

Telegraphy, Telephony and Signals

Localization of Breaks or Faults in Submarine Cables.—J. F. LLOYD.—The writer explains inaccuracies in measurements required for locating faults and gives the calculations for making the necessary corrections.—London *Electrician,* Oct. 31, 1919.

Telephone Repeaters.—BANCROFT GHERARDI and FRANK B. JEWETT.—In this paper the authors have endeavored to set forth briefly the history of the research and development work which has led up to the final production of successful telephone repeaters. The various forms of amplifiers which have been suggested are described and their possibilities and limitations pointed out. The essential properties of repeater networks, together with the necessary line conditions for successful repeater operation, are described and illustrated. Tandem operation of repeaters is discussed, as is also the use of repeaters in four-wire circuits.—*Proceedings A. I. E. E.,* November, 1919.



EARLY APPLICATION OF THE VACUUM TUBE TO TELEPHONE REPEATING SYSTEMS

Inter-Imperial Communication Through Cable Wireless and Air.—CHARLES BRIGHT.—The writer points out the dependence of the British Empire upon communication between the United Kingdom and the Dominions. He gives reasons for his belief that these systems should be under the control of the government as a matter of national defense. The author gives a table showing the principal British cable routes, approximate distances from London and the tariff rates.—London *Electrician,* Oct. 24, 1919.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities
in the Technical, Commercial and
Manufacturing Fields

News in Brief

Summary of Important Happenings in the Industry During the Week

One of the factors in the situation which attract attention is the still close tendency of money. Securities which find a ready sale under present conditions are those having speculative possibilities. These are snapped up quickly and they absorb free capital to the detriment of securities which offer merely a fixed rate of return. Utilities may be forced by this situation to try to market more of their securities directly instead of through banking houses. If they can do this at less cost than the commission charged by bankers, there will be a net saving.

On Jan. 1 Stone & Webster, Boston, admitted as partners Frederick P. Royce, George O. Muhlfeld, Henry B. Sawyer, Frederick S. Pratt, Harry H. Hunt and Howard L. Rogers.

The Empire State Gas & Electric Association announces a contest, open to employees of member companies, for statements on "Our Obligations to the Public." Two prizes, $15 and $10, will be paid.

Complete organization of the Radio Corporation of America has been effected. Owen D. Young, vice-president of the General Electric Company, is chairman of the board and the new company. Edward J. Nally, formerly vice-president and general manager of the Marconi Wireless Telegraph Company of America, is president. The General Electric Company has a large interest in the new company, which will develop commercial radio business between this country and South America and Europe.

Nicholas Stahl, general engineer Narragansett Electric Lighting Company, Providence, R. I., says that many engineers and superintendents of other central stations are traveling to Providence to see what is being done in the installation of oil-burning apparatus, now in operation.

On application of the General Electric Company, Howard C. Foss, district manager of Stone & Webster, has been appointed receiver of the Savannah (Ga.) Electric Company. The proceedings were in the United States District Court. The company operates the electric railway in Savannah. It also furnishes electric service, competing with another central-station company in the city.

A report on a recommended uniform registration law to regulate the practice of professional engineering, architecture and land surveying has been made to the Engineering Council by a committee of fifteen engineers representing the member societies.

Geological Survey statistics show a total output of 458,000,000 tons of bituminous coal in 1919, the smallest since 1915.

Action has been taken by the California Railroad Commission on security issues affecting two companies. The San Joaquin Light & Power Corporation may sell at 94½ plus accrued interest $494,000 of the issue of $1,250,000 bonds authorized on Aug. 20. The Pacific Gas & Electric Company is given until June 30, 1920, to dispose of the balance of the preferred stock issued as authorized June 30, 1919.

The San Francisco Electrical Development League has plans under way to give a farewell luncheon on Jan. 12 to R. H. Ballard, president of the National Electric Light Association, and John A. Britton, chairman of the public policy committee, before their departure for the East to confer on the program for the national convention at Pasadena in May.

The universal adoption of the metric system of weighing and measuring was advocated by speakers at the annual convention of the American Association for the Advancement of Science in St. Louis.

The California Railroad Commission has authorized the Sierra & San Francisco Power Company to add a surcharge of 2½ mills per kilowatt-hour to the rate charged for energy sold to the Coast Counties Gas & Electric Company.

A four-week campaign of stock selling to customers of the Public Service Company of Northern Illinois, Chicago, has resulted in sales of about $1,000,000 of 6 per cent preferred stock to about 5000 customers. This sale is still continuing, the company's employees acting as its selling agents.

The new year opens on the Pacific Coast with a general tone of optimism in all lines of industry. Christmas holiday trade electrically exceeded all previous estimates. Portland central stations report appliance sales in excess of 30 per cent of estimated volume In Los Angeles one dealer has just received a solid trainload of twenty-five cars of electric washing machines. The new year witnesses unusually heavy enrollment in universities of the West. The University of California passes Columbia and becomes the largest in America, with 9,685 students as against 8,204 in Columbia. Enrollment in the engineering courses is greatest among students pursuing electrical engineering, with 697 students enrolled. Vast new agricultural acreages are under way for the new year, requiring greater extensions of electrical services, electric pumps and appliances for the farm

Building holding over the old year and that anticipated for 1920, and expectations of extensions to central-station lines in certain sections, are causing buying far into the new year.

Virtually all the non-ferrous metals are higher than a week ago. Copper shows little advance, but its wire base at the mill is higher by ¾ cent and copper-wire rod is 1 cent higher Zinc and lead sheets are higher by ½ cent and 1½ cents respectively.

From virtually all over the country, but particularly the East, reports show an absence of the usual midwinter lull in electrical supply buying. Inventory has interfered little with business. Stocks are badly broken in such lines as some schedule materials, loom, flexible armored conductor and conduit, boxes, low-voltage porcelain, lamp and heater cords and tableware. Pipe stocks are spotty and wire is generally available.

Price advances over the last week of December and the first week of January have been applied to flexible armored conductor and conduit, friction tape, heating appliances, lamp cords and magnet wire, single-phase motors, knife switches, porcelain tubes, some time switches and unit lighting fixtures. Further motor and pipe advances are predicted.

Among the larger projects contemplated throughout the country is the construction of a large power plant at Amoskeag Falls by the Amoskeag Manufacturing Company of Manchester, N. H., to cost about $500,000.

Plans have been approved by the City Council for providing funds to complete the construction of the Los Angeles (Cal.) municipal power plant No. 2 in the San Francisquito Canyon by May 1.

F. M. FEIKER VICE-PRESIDENT OF McGRAW-HILL COMPANY

Former Editor of "Electrical World" Becomes Chairman of the Board of Editors of the Largest Technical Publishing House in the World

Frederick M. Feiker, editorial director of the ELECTRICAL WORLD, *Electrical Merchandising* and *Ingeniería Internacional*, has been elected vice-president of the McGraw-Hill Company and chairman of the board of editors.

A little over four years ago Mr. Feiker joined the McGraw organization as editor of the ELECTRICAL WORLD, coming from Chicago, where for three years he had been chairman of the editorial board of all the publications of the A. W. Shaw Company, among them being the magazines *System* and *Factory*.

FREDERICK M. FEIKER

The new vice-president of the McGraw-Hill Company was born at Northampton, Mass., in 1881, and in 1904 was graduated from the Worcester (Mass.) Polytechnic Institute in electrical engineering. After special research work in the field of high-tension transmission with Prof. H. B. Smith, he served from 1906 to 1907 as technical journalist with the General Electric Company. While in that work, which brought him intimately in touch with the trade and business publications of the country, he conceived the idea of a management paper devoted to all phases of manufacturing. His forward thinking in this connection resulted in his going to Chicago in 1907 as a member of the staff of *System*. Shortly afterward this idea of his became concrete in *Factory*, a magazine of management, of which he became managing editor. In 1912 he became chairman of the board of editors of all the A. W. Shaw publications.

With his early training in electrical engineering and his later experience in the field of selling and production economics as a background, Mr. Feiker, on returning to the electrical field in 1915 as editor of the ELECTRICAL WORLD, quickly sensed the pressing character of the commercial problems to be solved by the electrical industry and with characteristic vision and insight at once pointed out that the greatest development of the manufacturing and central-station groups could come only with the establishment of sound business principles and harmonious relations in the trade and distributing branches. With the assistance of William H. Onken, Jr., then managing editor and now editor of the ELECTRICAL WORLD, whose knowledge of the industry knew no bounds, and O. H. Caldwell, now editor of *Electrical Merchandising*, but at that time a member of the ELECTRICAL WORLD staff, Mr. Feiker developed what he called a "functional" paper on selling that would supplement and extend the service of the ELECTRICAL WORLD to the industry. The rapid growth of that paper, *Electrical Merchandising*, is testimony to the editorial and publishing genius of the recently elected vice-president of the largest technical publishing house in the world.

Mr. Feiker is a constructive thinker, with a resourcefulness of common-sense ideas that amazes even his associates who know him best. He has never been content in his editorial work to be a looker on but has gone down into the industry and there rubbed elbows with other leaders on committees in various electrical associations. No small share of the constructive thinking of the electric vehicle section of the National Electric Light Association in the past four years has been his. He is this year chairman of the New York Section of the Illuminating Engineering Society. He is also a member of the other principal engineering societes.

Mr. Feiker is a man of simple tastes and with a sympathetic nature that has endeared him to those who have been associated with him on the ELECTRICAL WORLD.

REPORT ON PRODUCTION OF BITUMINOUS COAL

Statistics of United States Geological Survey Show a Total Output for 1919 of 458,000,000 Tons, Smallest Since 1915

The report of the United States Geological Survey on bituminous coal production, issued on Jan. 3, shows an output of 8,621,000 tons of soft coal during Christmas week. This brought the total production from the beginning of the year to Dec. 27 up to the figure of 451,618,000 tons. With three working days remaining, this suggests a total bituminous output for the year 1919 of 458,000,000 tons. This is the smallest in any year since 1915. Compared with the 579,386,000 tons of the record year, 1918, it is a decrease of more than 121,000,000 tons.

The average for the week—85.5 per cent of normal—is not, however, a true measure of the extent to which operations have been resumed in the union districts, for neither the day before Christmas nor the day after count as full working days. A better measure is found in the fact that on Monday, Dec. 22, the output was 103 per cent of normal, or in the fact that compared with production at Christmas time of last year the week shows an increase of over 2,000,000 tons.

OIL-BURNING APPARATUS IN USE AT PROVIDENCE

Initial Installation of Narragansett Electric Lighting Company Is Now in Operation and Attracts Much Interest

Oil-burning apparatus, installed recently under two of the boilers at the South Street station of the Narragansett Electric Lighting Company, Providence, R. I., is now in use.

Nicholas Stahl, general engineer of the company, made the following statement regarding the beginning of the experiment with oil:

Some time ago the Narragansett Electric Lighting Company decided to make a thorough investigation of the possibilities of using oil as a fuel. We knew that stations on the Pacific Coast were equipped to burn oil exclusively, but there were none in the East, north of Florida, that made use of oil as regular fuel. The boilers, which were started this morning, will run regularly on oil, although it would be possible at any time to change back to coal at very short notice. We have constructed a service tank, holding 210,000 gallons, which will provide sufficient storage for the two boilers now in operation. The results secured will determine whether the oil-burning equipment will be extended, and at that time a large storage tank will be constructed.

Many engineers and superintendents of other central stations have been to Providence to examine what has been done, and it is evident that there is a very great interest among electric light companies in the pioneer step which the Narragansett company has taken.

WATER-POWER BILL IS NOW BEFORE THE SENATE

Senator Nelson of Minnesota Says Water-Power Construction Has Been at a Standstill for Ten Years

With the water-power bill the unfinished business in the Senate and with debate on it under actual headway, the chances seem favorable for fairly prompt disposal of the measure. Senator Lenroot of Wisconsin, who is leading the opposition, has made clear his position, and apparently the differences between his views and those of other members of the Senate are capable of reconciliation.

Senator Walsh of Montana, who is regarded as one of the authorities in the Senate on water-power matters, deprecated the action of the committee in injecting again into the debate the controversy as to the length of the license.

Senator Smoot entertains opposite views. "I think if the pending amendment is not agreed to," he said, "the provisions of the bill will be such that it will be very difficult indeed to get any financial assistance in the United States to install power plants under it. So far as the provisions of the bill are concerned, there are other things in it that I do not like at all, as to which I am willing to yield my judgment in order to get some kind of a workable bill so that every power site in the United States upon the public lands may be developed. There is no need of framing the bill in such a manner that it will be impossible to secure the necessary money to develop the power plants."

Senator Nelson of Minnesota made the chief plea in favor of the bill. He pointed out that water-power construction has been at a standstill in the country for ten years. He reviewed the various delays and the differences of opinion between the Senate and the House which have worked to delay the measure. He told how finally the conferees at the last session of Congress had agreed at the eleventh hour, but in the jam of legislation at the end of the session the Senate was unable to agree to the conference report and the measure died with the Congress. The present bill, he declared, is practically the same bill that was agreed on in that conference. The amendments which were made by the Senate committee he characterized as in no way changing the general purport of the bill agreed upon in conference.

NEW MEMBERS OF FIRM NOW IN STONE & WEBSTER

Frederick P. Royce, George O. Muhlfeld, Henry B. Sawyer, Frederick S. Pratt, Harry H. Hunt and H. L. Rogers Become Partners

Stone & Webster, Boston, announced Jan. 1 that Frederick P. Royce, George O. Muhlfeld, Henry B. Sawyer, Frederick S. Pratt, Harry H. Hunt and Howard L. Rogers had been made partners in the firm. All have been leading members of the organization for years and have had important parts in its activities.

Mr. Royce is a graduate of the Massachusetts Institute of Technology, class of 1890, and for many years has been occupied in the development, financing and management of public utilities. For some time before becoming associated with Stone & Webster he was active in the executive affairs of Charles H. Tenney & Company, Boston, and lately has been in charge of the investigation by Stone & Webster of the Interborough and Brooklyn Rapid Transit companies.

Mr. Muhlfeld was educated at Purdue and Cornell universities, and, after several years of responsible direction of hydroelectric construction for Stone & Webster in the West, was appointed construction manager of the organization. He is at present general director of the division of engineering and construction, with headquarters in the New York office.

Mr. Sawyer has for many years served as treasurer of the public utilities operated by Stone & Webster. He is prominent in philanthropic work in Boston and is a trustee of the Boston Symphony Orchestra. At present he is heading a party of engineers and investigators for Stone & Webster on a trip to Japan, where a 30,000-kw. hydroelectric plant is to be built by the firm, with other important contracts pending.

Mr. Pratt has been employed by Stone & Webster since his graduation from Harvard College in 1894. He has directed various industrial chemical enterprises under Stone & Webster management and of recent years has had charge of a group of Stone & Webster properties in the Northwest, the most important being the Puget Sound Traction, Light & Power Company of Seattle, Wash. Mr. Hunt was graduated from the Massachusetts Institute of Technology in 1889, and for many years has been active in public utility management, looking particularly after various Southern properties of Stone & Webster. Mr. Rogers, a graduate of the Massachusetts Institute of Technology in 1893, has been continuously in the engineering and construction division of Stone & Webster since that time. He is now in charge of the home office of this division at Boston.

Semi-Annual Index for Volume LXXIV

The semi-annual index of the ELECTRICAL WORLD for the issues from July to December, 1919, inclusive. is printed as a supplement with this number. Any readers desiring to bind the numbers for this volume in two parts because of the difference in page size between the papers printed in New York (covering July, August and September) and those printed in Buffalo under strike conditions (covering October, November and December) will, on application, be supplied with a second copy of the index which can be trimmed to the smaller size of page.

WORK OF THE SIGNAL CORPS DURING THE MONTHS OF WAR

The Report of General Squier, Chief Signal Officer of the Army, Gives Credit to Manufacturers for Development Efforts

In last week's issue of the ELECTRICAL WORLD, page 35, extracts were printed from the annual report of Major General George O. Squier, chief signal officer of the army. These are now supplemented by additional excerpts.

In a chapter on "Engineering and Research in America" General Squier gives much information:

Major C. E. Mendenhall and Lieut. John T. Tate, with the assistance of the General Electric Company, perfected a trench-signaling lamp which after test at the front was ordered sent to France in considerable quantities. Major R W. Wood developed a telescopic signaling device, using a 6-volt, 2 amp. lamp. This lamp was tested at the front and favorably passed upon by the American Expeditionary Forces. It has made possible light signaling in broad daylight over a distance of 18 miles (28.8 km.). Major Wood also developed a secret daylight signaling lamp which has a range of 5 miles (8 km.). This also was ready for shipment abroad at the time of the signing of the armistice. Secret signaling at night, with the aid of the ultra-violet light, was perfected by the Science and Research Division, working in collaboration with Norman Marshall. With simple signaling telescopes of the sort mentioned above, using only a 6-volt, 2-amp. lamp, secret signals have easily been sent 6 miles (9.6 km.). Major Wood also developed new means of adapting this method to the problems of signaling to airplanes and secret signaling between convoys and obtained thereby a device which will be of much use in peace as well as in war.

The report says that in general it is not believed that there is any telephone or telegraph system so far devised that will prevent a line from being actually tapped and all signals sent over it obtained without the knowledge of the sending or receiving station.

General Squier says that the remarkable development and improvement of military radio equipment which has taken place under the direction of the Signal Corps during the last eighteen months will undoubtedly materially change the system of army communication. A typical example of this development is the airplane radio telephone.

In carrying out the program for development of radio apparatus the Signal Corps called upon a great many industrial engineering organizations and individual engineers for assistance in solving the problems incident to this work. General Squier says:

It is impossible to print a complete list of the companies and individuals that contributed effectively to this work, but the contributions which have been made by certain companies have been so noteworthy as to justify mention in this article. Because of its unusually large engineering organization and its familiarity with so many of the fundamental problems which were involved in the development of radio apparatus for the Signal Corps, the Western Electric Company has contributed much more largely to this program than any other organization. However, the contributions which have been made to the development work by the Westinghouse Electric & Manufacturing Company, the General Electric Company, the International Radio Company, the General Radio Company, the De Forest Telephone & Telegraph Company, the National Electric Supply Company and the Marconi Wireless Telegraph Company have been of incalculable value to the Signal Corps during this emergency. It is particularly worthy of comment that all of these companies, and, in fact, any others with which the Signal Corps worked on the development of radio apparatus, evinced the most whole-hearted cooperation, with the sole purpose of assisting in every way to further the effectiveness of the American army.

The opinion is also expressed that the art of radio communication in general will be benefited enormously

MAJOR-GEN. GEORGE O. SQUIER

by the revolutionary improvements that have been effected in certain of the parts of radio apparatus, notably the vacuum tube. On the subject of the development of vacuum tubes the report says in part:

To make such a device, with its complicated yet accurately constructed metallic system within a practically perfect vacuum, is no small problem even when made in the laboratory on the individual unit basis by a skilled operator who appreciates the delicacy of the job. To turn out tubes by the thousands by factory methods involves almost infinitely greater difficulties. How well certain companies, in collaboration with the Signal Corps, have succeeded in solving these difficulties is indicated by the fact that recently the total rate of production in the United States of high-quality standardized tubes was considerably in excess of 1,000,000 a year.

Varied as are the applications at present, the uses, actual and potential, growing out of war-development work have proved that the art of vacuum-tube engineering and the application of its products to radio engineering, telephone and telegraph engineering, and particularly to electrical engineering in general, are still in their early infancy. That vacuum tubes in various forms and sizes will, within a few years, become widely used in every field of electrical development and application is not to be denied.

The Chief Signal Officer considers that the work of standardization and quality production of vacuum tubes, accomplished during the last eighteen months, under the pressure of military necessity, represents an advance in the art of electrical engineering which will prove of inestimable industrial and scientific value to this country and to the engineering world at large.

Promoting Lighting Development in England

THE ELECTRICAL DEVELOPMENT ASSOCIATION,

84, Kingsway, W.C.2.

Telephone: Holborn 253.

LIGHTING SEASON—1919-1920.

Artificial Lighting has been restricted for five years.

Economy and increased production are the needs of the day.

In the coming six months, work and recreation will be carried out to a great extent by artificial light.

Good Lighting increases output, saves strain, adds to comfort, reduces accident and waste.

Electric Lighting saves fuel, preserves health and insures nothing.

Platitudes! Exactly; but most of the troubles of this life arise from neglect of the obvious.

Are all the people in your district using electricity for Lighting? Are those who do use it provided with the best lamps and with the latest fittings? Has anyone advised them or overhauled their installations since 1913?

The modern electric lamp fitted in the modern way gives satisfaction to everyone, in appearance, utility and cost —**a bright and silent canvasser for a great Public Service.**

This is the call of England's Electrical Development Association to stimulate after-the-war interest in electric lighting.

ENGINEERING COUNCIL ACTS ON REGISTRATION OF ENGINEERS

Committee Representing the Various National Societies Makes Report with Draft of Recommended Uniform Registration Law

Because of widespread and persistent interest in the subject of licensing or registering engineers, architects and surveyors, the Engineering Council, at its meeting of Oct. 25, 1919, authorized the creation of a committee to make a thorough study and submit a report. Fifteen engineers from all parts of the country and of long experience in the various branches of the profession of engineering were appointed members of this committee, as follows: T. L. Condron, chairman; Francis C. Shenehon, Farley Gannett, John H. Dunlap, Arthur M. Greene, Jr., Caleb M. Saville, James H. Herron, John Klorer, A. Lincoln Fellows, C. H. Snyder, Amos Slater, Bion J. Arnold, John W. Alvord, J. W. Woermann and A. M. Schoen.

After much hard work, extending through fourteen months, the committee has presented a report to the Engineering Council. This is accompanied by a "recommended uniform registration law, to regulate the practice of professional engineering, architecture and land surveying." The council voted to receive this report and to give it immediately, together with the proposed law, as wide publicity as could be secured with the aid of the engineering and architectural societies and the technical journals, in order that the members of these professions might be informed and discussion elicited to guide the council in the consideration of this important matter at its meeting in February, 1920.

The Engineering Council has as yet taken no action upon the merits of the question of the advisability of legislation providing for the registering or licensing of practitioners of the professions named.

ORGANIZATION OF RADIO CORPORATION OF AMERICA

Owen D. Young Is Chairman of the Board and Edward J. Nally the President—General Electric Company Has Large Interest

Organization of the Radio Corporation of America, in which the General Electric Company owns a large interest, has been completed. Owen D. Young, vice-president of the General Electric Company, will be chairman of the board of the new company. Edward J. Nally, formerly vice-president and general manager of the Marconi Wireless Telegraph Company of America, is president.

The other officials are: Charles J. Ross, secretary and controller; George S. De Sousa, treasurer; Lewis MacConnach, assistant secretary; Marion H. Payne, assistant treasurer; John W. Griggs, general counsel.

Following are the directors: Gordon Abbott, chairman of Old Colony Trust Company, Boston; Albert G. Davis, vice-president General Electric Company; John W. Griggs, formerly Attorney General United States and ex-Governor of New Jersey; Edward W. Harden, of James B. Colgate & Company; Edward J. Nally; Edwin W. Rice, Jr., president General Electric Company; James R. Sheffield, of Sheffield & Betts; Owen D. Young, vice-president General Electric Company.

It is stated that arrangements have been made with Marconi's Wireless Telegraph Company, Ltd., of England, for the formation of a South American company, to be managed by the company of this country. A majority of the stock in various companies which are to construct stations in South America will be owned by the Radio Corporation of America.

President Nally states that the corporation will compete directly with the cable companies on overseas business as soon as its property is returned by the federal government. It will reach Europe as well as South America.

The official announcement says in part:

Under new conditions of financial strength and in possession of the engineering resources of the General Electric Company, with a departmental staff of exceptional experience and ability, the company expects to attain the great objective for which it has always aimed, namely, a world-wide system of commercial wireless communication.

In accordance with what is understood to be the wishes of the United States government, effective means have been taken to see to it that the actual control of the Radio Corporation shall at all times remain in the hands of loyal American citizens or corporations.

In fact, it was at the instigation of our government, which desired that the former American company be entirely divorced from its parent company in England, that the Radio Corporation was formed. Owing to the greatly increased use of wireless by the United States government during the war the government has come to regard the subject of wireless as one of very vital importance to this country, especially from a military standpoint, and consequently looked with grave concern upon the participation on the part of a foreign corporation in American wireless affairs. These objections have now been eliminated.

Wireless apparatus developed recently by the General Electric Company, including the Alexanderson high-frequency alternator, is acquired by the new company.

PROGRESS OF THE N. E. L. A. OVERHEAD SYSTEMS COMMITTEE

Reports Submitted at the Denver Meeting Show that Much Interesting Information Can Be Collected Regarding New Methods

A report of the recent Denver meeting of the overhead systems committee of the National Electric Light Association has been made available. The meeting was held in the offices of the Denver Gas & Electric Company.

Those in attendance were as follows: Markham Cheever, Salt Lake City; R. L. Baker, New York City; Thomas Sproule, Philadelphia; W. T. Oviatt, Providence, R. I.; W. T. Morrison, New York; L. M. Klauber, San Diego, Cal.; R. E. Cunningham, Los Angeles, Cal.; W. G. Kelley, Chicago; R. A. Hammack, Denver, Col.; H. H. Kerr, Denver, Col.; John B. Fisken, Spokane, Wash; H. R. Wakeman, Portland, Ore.; A. E. Silver, New York; J. E. Woodbridge, San Francisco, Cal.; W. K. Vanderpoel, Newark, N. J.

Reports of the various sub-committees were submitted, and it was found that there had been a very gratifying response to the questionnaires issued by the sub-committees. From the data in hand it was indicated that much interesting information can be collected regarding new construction and maintenance methods and devices. The greatest interest is being displayed in the question of insular maintenance, so that more information can be collected regarding their operating performance and the necessary remedies can be worked out to eliminate the causes of insulator failures. It was felt at the meeting that a special study should be made of the causes of failures of suspension insulators and that such research should be continued until this part of the outside plant equipment can be depended upon to give continuous and satisfactory results. There were interesting discussions and developments regarding many construction and maintenance details.

MERCHANDISING AND LIGHTING SCHEDULES OF THE N. E. L. A.

Division on Co-ordinate Advertising and Sales Campaigns of the Commercial Section Issues Its Outline for Special Drives

The Commercial Section of the National Electric Light Association, under the direction of its division on co-ordinate advertising and sales campaigns, is about to put into effect the plan which it submitted to the 1919 convention at Atlantic City.

This plan provides for the issue of monthly reminders by the section, calling attention to the merchandising schedule under which it is expected that special drives will be made on certain devices each month in the year. These reminders will be sent to the central stations six or eight weeks in advance of each monthly special sale or drive, and it is proposed to list on these monthly reminders the manufacturing companies which are prepared to supply advertising matter on the appliances or devices appearing on this schedule.

The purpose of having these reminders reach members six or eight weeks in advance is that they shall be enabled to obtain such advertising matter as may be available from manufacturers and to enable them further to supplement such free matter with any other forms of advertising which they may desire. At the same time, special articles will appear in the N. E. L. A. Bulletins, and all manufacturers are asked to co-ordinate their advertising with the schedules as far as possible when making up their advance plans for publicity.

The division on co-ordinate advertising and sales campaigns comprises: E. B. Atchley, F. R. Davis, Willard Hall, R. C. Jones, J. S. Kennedy, H. H. Koelbel, J. C. McQuiston, W. R. Roberts, M. Wakeman and Henry Harris, chairman.

The two schedules follow:

Merchandising Schedule.—January, clearance sale; February, heating pads; March, vacuum cleaners; April, sewing machine and sewing-machine motors; May, grills; June, flatirons; July, fans; August, clearance sales; September, washing machines; October, radiant heaters; November, toasters; December, electrical Christmas gifts.

Lighting Schedule.—January, better lighting; February, outdoor lighting (tennis courts, playgrounds, etc.); March, stores and windows; April, residence; May, electrical advertising (signs, outline lighting, display lighting, etc.); June, public buildings; July, industrial; August, stores and windows; September, electrical advertising (signs, outline lighting, display lighting, etc.); October, residence; November, better lighting (with emphasis on office buildings); December, industrial.

MEETINGS OF N. E. L. A. COMMERCIAL SECTION

Many Committees Get Together This Week to Make Plans for Reports to be Presented at the Pasadena Convention

A number of meetings of committees of the Commercial Section of the National Electric Light Association were held on Monday, Tuesday, Wednesday and Thursday of this week. With the exception of the meeting of the Power Sales Bureau, which was held at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company, all of the meetings were held at association headquarters in New York.

The meetings were very well attended. Arrangements were made to develop reports for presentation at the Pasadena convention. In a majority of cases, it is announced, manuscripts of these reports will be made available around Feb. 1, so that advance copies may be available to facilitate discussion.

The schedule of meetings follows:

Monday, Jan. 5—Commercial service and relations with customers' committee, R. F. Bonsall, chairman; standardization and testing division (merchandise sales bureau), Oliver R. Hogue, chairman; merchandise sales bureau, E. A. Edkins, chairman; lighting sales bureau, Clarence L. Law, chairman; co-ordinate advertising and sales campaigns division (advertising and publicity service bureau), Henry Harris, chairman; compensation of salesmen committee, Adolph Hertz, chairman; newspaper advertising campaigns division (advertising and publicity service bureau), Mathias Turner, chairman; publications division (advertising and publicity service bureau), Cyril Nast, chairman; adequate service outlet division (advertising and publicity service bureau), P. L. Thomson, chairman.

Monday, Jan. 5.—Commercial service and relations with Oliver R. Hogue, chairman; merchandise sales bureau, E. A.

Tuesday, Jan. 6 — Advertising and publicity service bureau, L. D. Gibbs, chairman; "Electrical Salesman's Handbook" committee, I. Lundgaard, chairman; power sales bureau, R. H. Knowlton, chairman; wiring committee, R. S. Hale, chairman.

Wednesday, Jan. 7.—Executive committee commercial section, John G. Learned, chairman.

Thursday, Jan. 8 — Committee on education, Fred R. Jenkins, chairman.

GOVERNOR AND COMMISSION AT ODDS IN NEW JERSEY

Commission Points Out Tendency to Demand that It Grant Whatever the People Demand, Without Regard to Rights of Utilities

A charge of willful neglect of duty made against the Board of Public Utility Commissioners of New Jersey by the City Commission of Montclair has been dismissed by Governor Runyon. The Governor declared that he found no intentional wrongdoing in the approval of the zone fare system of the Public Service Railway Company, but that the commission had lost public confidence and that he would remove some members if he could do so.

The statement of Governor Runyon said in part:

As to the judgment of the board in establishing the rates which resulted in the bringing of these charges I have nothing to say, as possible errors of judgment do not enter into the controversy.

But it is clear to me that the Board of Public Utility Commissioners has long since lost the confidence of the public, and the public confidence once having departed, the board's usefulness is also gone. In the present case, and with the importance and far-reaching effects of this board's decisions, suspicion and mistrust loom large and become epidemic. This is peculiarly unfortunate in this day of ever-rising prices.

For some members of the board I have great respect. I believe thoroughly in their honesty and know them to be possessed of large ability. But, unfortunately, certain members of the board have proved themselves out of place. I will grant that they are honest and sincere, but their unfitness is so marked that every member of the board, able and incompetent alike, has been made to suffer. And with the present membership of the board maintained without a break, conditions will not improve. I am, therefore, free to say that if the absolute power of removal were mine I should exercise that power at least to the extent of removing from said board those whom I considered unfit, replacing them with men whose honesty would be coupled with notable ability, to the end that the public should know that their interests were in fair and competent hands.

The Legislature has the power to protect the public interest by abolishing the existing commission and creating a new one. While I voted in the Senate for the bill which added two members to the original board of three members, I did so in the belief that the public interest and volume of business demanded such additional members. I no longer believe that to be the case, but am convinced that three members are amply sufficient for the proper transaction of the business of the board.

Commenting on the criticism of Governor Runyon, the board issued a statement in which it said:

The board is gratified that the complaint of Montclair was legally and judicially disposed of by the acting Governor. It is to be regretted, however, that he should have so unfairly abused the power of his office by indulgence in an unjust criticism of the personnel of the board, using the proceedings before him as an excuse for so doing. His action rather lends credence to much of the criticism which has been leveled at him during the whole proceeding.

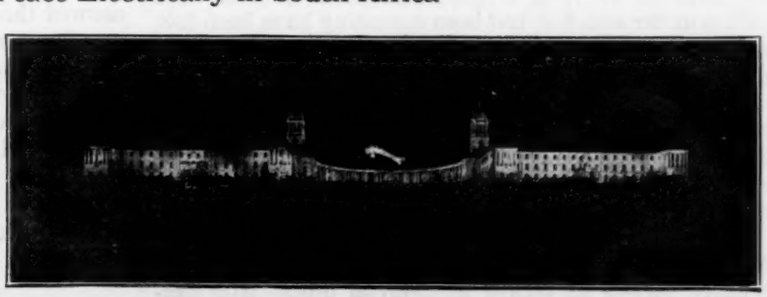
In its annual report, just issued, the board asks the Legislature to investigate its administration, and particularly its authorization of rate increases.

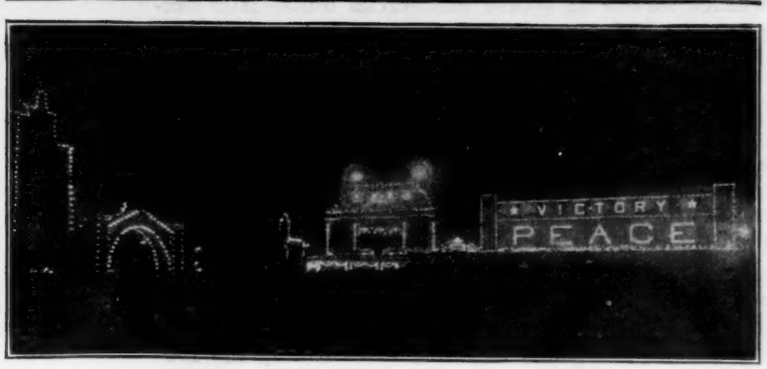
The report charges that there has been a tendency to demand that the commission grant whatever the people demand, without giving the rights of public utility companies any consideration. It continues:

Such a contention can lead only to disaster. Its primary effect would be widespread ruin of public utility enterprises. After this would come demoralization of service.

Though the allowances of increased fares may result in misunderstanding and false charges of favoritism to corporate enterprises, the public officials upon whom the law imposes the duty of increasing rates when existing rates are insufficient must perform this duty, disagreeable as it may be. It seems to us that in much of the recent discussion of the public utilities question this fact is not appreciated.

Celebrating Peace Electrically in South Africa





During a recent peace celebration in Pretoria, the capital of South Africa, the administration buildings were illuminated by floodlights, as shown in two of the illustrations. Church Square was also specially illuminated for the occasion. The illumination received so much favorable comment that it was suggested that it be retained permanently.

PRIZE CONTEST ON "OUR OBLIGATIONS TO THE PUBLIC"

Empire State Gas & Electric Association to Give Two Cash Prizes for Best Statements on This Topic

A prize contest for statements on the obligations of gas or electric companies and their officers and employees to the public that they serve is announced by the Empire State Gas & Electric Association. A first prize of $15 and a second prize of $10 will be paid.

The contest is open to any employee of a member company. Statements must be of not more than 300 words and must be received in the association office not later than Jan. 20. M. H. Aylesworth, executive assistant to the president of the National Electric Light Association, will be judge.

FOUR TYPES OF LIGHTING MAINTENANCE DISCUSSED

Commercial Maintenance, Central-Station Maintenance, Street-Lighting Maintenance and Boulevard Lighting Maintenance Form Topic

At a recent meeting of the Chicago Section, Illuminating Engineering Society, J. L. Stair, National X-Ray Reflector Company; F. A. Kaup, supervisor of service and repair department, Commonwealth Edison Company; Henry Nixon, deputy commissioner of gas and electricity, city of Chicago, and C. H. Shepherd, electrical engineer, Lincoln Park Commissioners, discussed the maintenance of the various types of lighting equipment under their direction.

Mr. Stair recited the experience of a commercial cleaning company which had been in the window-cleaning business and had gone into the fixture-cleaning business. This company, with the co-operation of the National X-Ray Reflector Company, has been able to build up quite a profitable business, which will perhaps be extended to other cities in the near future. The prices under which it has been operating have been low, owing to the fact that it can employ the same class of labor ordinarily used in cleaning show windows. Its average charge has been 21 cents per unit, but the prices have varied from 13 cents per unit to 38 cents per unit, depending upon the conditions. This price includes one cleaning per fixture per month and also includes incidental breakage which occurs during cleaning.

Mr. Kaup recited the experience of the Commonwealth Edison Company in conducting its lighting unit maintenance service on 50,000 commercial units, 3100 electric signs and a number of arc lamps. This company makes a charge of 35 cents per unit for this service.

Mr. Nixon reviewed the experience of the city of Chicago in maintaining about 50,000 street lamps which it operates. On this work it has been necessary to use high-priced experienced electrical labor and to pay the union scale. This naturally resulted in higher costs. It has been found that a man with a machine can patrol 1100 lamps of the type on high standards and the man without a machine can patrol 550 lamps. Of the lamps on the 10.5-ft. standards 1500 can be patrolled by one man. This is handled by men in machines exclusively. The cost of patrolling, renewing and cleaning the 100-cp. lamps is $2.84 per unit. This is divided into $1.80 for patrolling and renewing and $1.04 for cleaning. The cost for the 600-cp. lamps is $5.70 for patrolling, renewing and cleaning, of which $3.60 is for patrolling and renewing and $2.10 is for cleaning. Fifty lamps per day is considered a day's cleaning work for one man. This is usually handled by placing a man in a district and making him responsible for the district. The gang system of cleaning has been tried out and it appears to be better, although experience with it is limited to date. The city is now getting 2200 hours' average light out of its incandescent lamps and has discontinued its former exact method of checking lamp life. The life of a special lamp which the city is using will run to 3000 hours' average burning.

Some startling costs taken from the beautiful ornamental system in Lincoln Park and on Chicago's north side boulevards were given by Mr. Shepherd. The 20-in. alabaster globes which the Lincoln Park Commission now uses on top of its high concrete standards cost something over $16 each. In the fiscal year of 1919 there were 171 breakages, this amounting to 10 per cent of the cost of maintenance of the system. Mr. Shepherd discussed special troubles which occur on lamps located near the lake, where insects proved an unusual nuisance. He also pointed out that it had been necessary to adopt the use of railway-type incandescent lamps in "islands of safety" because of the vibration caused by motor buses operating on the boulevards. He stated that lamps of different manufacture give different life records, but the average life record as shown by lamps on the Lincoln Park street-lighting system was about 2800 hours. The present cost of operating this system is about 60 per cent of the cost of operating the arc-lamp system which it replaced. Cleaning occurs about once every two weeks.

In the discussion E. D. Tillson of the Commonwealth Edison Company described and demonstrated a self-cleaning fixture which the company is now recommending for foundries, cement mills and other applications where dust prevails. A. L. Ahrenberg of the Central Electric Company demonstrated an industrial type fixture in which the lamp is totally inclosed in a dust-proof glass inclosure. He stated that tests on this unit showed that the lamp operated at a temperature which was lower at the leading-in wires with the lamp totally inclosed than it would be if the inclosure had a hole at the bottom and one at the top for ventilation. When the holes were in the inclosure the "chimney effect" caused an increase in lamp temperature at the leading-in wires.

By-Product Service of the Electric Fan

SLICING CUCUMBERS

We don't guarantee success, and would like to know what luck others have before we try it on ours.—*The Exciter, Houes Organ of the Central Maine Power Company.*

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Philadelphia Section.—"Electrical Construction Problems" will be discussed by this section of the American Institute of Electrical Engineers at its Jan. 12 meeting.

A. I. E. E., Boston Section.—"Storage Batteries—Their Many Applications and Methods of Operation" was the subject of a talk given by J. Lester Woodbridge, chief engineer Electric Storage Battery Company, Philadelphia, at the Nov. 12 meeting held by this section of the Institute.

Massachusetts Association of Electrical Contractors and Dealers.—Frank S. Price, president Pettingell-Andrews Company, Boston, will address the Boston district of the association at the Boston City Club Jan. 15 at 1 p.m. upon the relation between the jobber and the contractor. A question period will follow the usual luncheon and address.

Massachusetts State Association of Electrical Contractors and Dealers, Boston, District.—The Nov. 20 meeting of the Boston District of the association was addressed by Francis A. Williams, clerk of the State Board of Examiners of Electricians, who read a paper on the workings of the license law passed in Massachusetts in 1915.

Peoria Electrical Men Form Club.—The Peoria (Ill.) Electric Club has been organized by Peoria men interested in the electrical merchandising, contracting and lighting business. R. S. Wallace, manager of the Central Illinois Light Company, addressed the club at its first meeting, and it is planned to have other meetings during the year.

The Southeastern Section, N. E. L. A.—A meeting of the executive committee, Southeastern Section, was recently held in Atlanta at which appointments were made of chairmen of the various standing committees for the coming year. President Tillery announced that the second meeting of the executive committee would be called either in the middle of January or the early part of February, to take up matters of importance to the section.

New Officers and Directors of the Engineers' Club of San Francisco.—Ely C. Hutchinson, manager of the engineering and sales department, Pelton Water Wheel Company, San Francisco, is the new president of the club; J. E. Woodbridge is first vice-president, Edwin Duryea, Jr., second vice-president, Charles C. Hardy treasurer, and Allen G. Jones secretary. The newly elected directors are Bruce Lloyd, Charles E. Townsend, A. E. Chandler, B. P. Legare, Abbot A. Hanks, E. O. Shreve, A. H. Halloran and W. G. Vincent, Jr.

A. I. E. E., Denver Section.—A. L. Powell, illuminating engineer Edison Lamp Works of the General Electric Company, Harrison, N. J., addressed this section of the American Institute of Electrical Engineers on "Late Developments in Industrial, Store and Residence Lighting" at its Nov. 22 meeting.

Boston Edison Section, N. E. L. A.—At the annual meeting of the section on Nov. 17 the following officers were elected: President, J. C. Norcross; first vice-president, J. C. Redmond; second vice-president, J. J. Buckley; secretary, W. S. Holway; treasurer, W. L. Frisbie; executive committee, G. H. White, W. E. Gould, T. E. Penard, S. C. Clough.

Jewett Addresses Engineers of Spokane.—Under the auspices of the local section of the American Institute of Electrical Engineers, Dr. Frank B. Jewett, chief engineer Western Electric Company, spoke to the Associated Engineers of Spokane, Wash., on Nov. 14, his topic being "Some War-Time Developments in Electrical Communication and Allied Fields."

A. I. E. E., Panama Section.—On Nov. 3 this section of the American Institute of Electrical Engineers inspected the United States naval submarine base at Coco Solo, Canal Zone. Lieut. A. L. Vaughn, engineer officer, and W. L. Hersh, electrical engineer of the Panama Canal, who designed the submarine storage-battery-charging station, delivered talks during the day.

Joint Meeting, A. I. E. E., St. Louis Section, and Associated Engineering Societies of St. Louis.—Otto B. Blackwell, transmission and protection engineer, American Telephone & Telegraph Company, addressed the Nov. 19 joint meeting of the St. Louis Section, American Institute of Electrical Engineers, and the Associated Engineering Societies of St. Louis on the subject of "The Telephone Transmission Circuit."

American Physical Society.—A symposium of papers on the electron tube was given at the meeting of the society held in Chicago on Nov. 28 and 29. The papers included "Phenomena in Pure Tungsten Filament Electron Tubes," by Irving Langmuir, General Electric Company; "Phenomena in Oxide-Coated Filament Electron Tubes," by H. B. Arnold, Western Electric Company; "The Relations of the Constants of an Electron Tube to Its Physical Dimensions," by L. A. Hazeltine, Stevens Institute of Technology; "Theory of Action of Electron Tubes as Amplifiers," by John M. Miller, Bureau of Standards; "Theory of Action of Electron Tubes as Generators," by John H. Morecroft, Columbia University; "High-Power Transmission Sets," by W. C. White, General Electric Company; "Telephone Sets," by O. B. Blackwell, American Telephone & Telegraph Company, and a paper by E. H. Armstrong, major, U. S. A.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Power Surcharge.—In a case affecting the Empire District Electric Company the Missouri Public Service Commission substituted a surcharge for thirteen months of 5 mills per kilowatt-hour for a proposed surcharge of 6 mills on rates to power consumers in order that some emergency relief from increased operating expenses may be afforded an electric utility not seeking a return based on the full value of its property.

Depreciation Charge.—In granting the petition of the Big Springs Electric Company for authority to discontinue a flat charge the Utah Public Utilities Commission found that the earnings of the company had been sufficient to pay as much as 10 per cent on the investment. It appeared that the company was not setting aside any amount for depreciation. The commission held that at least 3 per cent should be set aside from earnings as a depreciation fund. The meter system was authorized.

Vaule of Plant.—In a rate case involving the Mercersburg, Lehmasters & Markes Electric Company the Pennsylvania Public Service Commission says: "It is proper to recognize that where a judicious investment has been made in the utilization of an existing property to greater or less extent, a value may be created greater than the actual investment made, which should be recognized by the commission in its conclusion. The exercise of good judgment and forethought, as well as the taking advantage of a situation, may, and often does, result in the creation of values which, in connection with the investment itself, should be considered in arriving at a fair value."

Minimum Charge.—The Public Service Commission of Pennsylvania refused to permit the Panther Valley Electric Company to increase its minimum charge when it could not show that the increase was actually necessary in order to be in a position to serve its customers or to pay its operating expenses and yield a fair return on its investment. The commission held that a minimum charge should always be considered in connection with the other elements of the rate schedule. Where the existing schedule afforded sufficient revenue it should not be altered by the addition of a minimum charge unless the rate schedule be lowered in such an amount that the revenue derived from this service would be decreased in about the same amount that the revenue derived from the minimum charge would be increased.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Rates Increased on the Minidoka Project.—An increase in rates has been announced by the government in electric service for Rupert, Idaho. Light and power rates are to be increased approximately 20 per cent and heating rates from $1.25 to $2 per kilowatt. The government has also ordered the segregation of the heating system from the lighting and power circuits.

Electric Vehicles of Baking Companies. — A list of twenty-five baking companies which use electric vehicles has been compiled by A. Jackson Marshall, secretary Electric Vehicle Section, National Electric Light Association. It is headed by the Ward Baking Company, with a total of 400 vehicles at its branches in eight cities. The twenty-five concerns have approximately 1200 electric delivery wagons in service at the present time.

City Saves $15,000 Through Central-Station Service. — Two years ago the City Council of Grand Forks, N. D., signed a contract with the Red River Power Company (Northern States Power Company) for electric energy for operation of its water-pumping supply system and street-lighting system. At a recent meeting of the City Council a report showed that in the twenty-three months of the contract the city had saved $14,846 compared with the cost of operating its own plant.

Standardization of Army Electrical Equipment.—Every article used by the military establishment from a scratch pad to a tractor is in process of standardization. As some 300,000 different articles are used by the army, the magnitude of the task is obvious. Considerable progress has been made in the standardization of electrical equipment. This part of the work is perhaps further advanced than any other owing to the exigencies of the war period. Early in the war the lack of standardization in electrical equipment made it necessary for the engineers with the American Expeditionary Forces to cable lengthy specifications for articles needed. These orders were often rendered unintelligible in transmission, and, worse still, greatly taxed the capacity of the transatlantic cables to carry such a volume of matter. A single uniform catalog was hastily produced from which orders were made in the future by mere reference to numbers. Now all the electrical equipment needed by the nine supply branches of the army has been catloged.

Electric Steel Production.—According to statistics compiled by the Electric Furnace Association, in total tonnage production of ordinary steel castings the electric furnace has already passed the crucible and in 1918 it was approaching the converter casting output. In making this comparison it should be borne in mind that the same class of castings is not made in these two processes. In 1918 production of electric steel castings was nearly five times that of 1915.

H. M. Byllesby & Company Acquire Investment Banking Business.—The investment banking business of R. S. Moore & Company has been acquired by H. M. Byllesby & Company. R. S. Moore has been elected a vice-president of H. M. Byllesby & Company and will have under his charge the management of the investment banking business in the New England States, with offices at 30 State Street, Boston, and 10 Woybosset Street, Providence.

New Hydroelectric Installation for Madagascar. — According to Consul James G. Carter, Tananarive, Madagascar, the installation of an electric light system for Tamatave, the principal port of Madagascar, is under consideration by the authorities there, and the project has the approval of the Governor-General. Waterfalls capable of developing 3000 hp. are available 10 to 15 miles west of the city, and part of the utilization of this power will probably be taken up with the electrification of the railway at that point and with electrometallurgical and electrochemical industries.

Great Growth of Two Ohio Companies.—Rapid growth has taken place in the business of the Trumbull Public Service Company, of Warren, Ohio, and the Massillon (Ohio) Electric & Gas Company, two subsidiaries of the Cities Service Company. The Trumbull company had a switchboard output of 5,693,426 kw.-hr. of energy in 1912, while the maximum demand in the twelve months ending Dec. 31, 1912, was but 1550 kw. For the first nine months of 1919 the Trumbull company had a switchboard output of 51,957,357 kw.-hr. of energy, with a maximum demand in these nine months of 21,000 kw. It is estimated by the management that the total switchboard output in 1919 will exceed 72,000,000 kw.-hr., with a maximum demand of 22,500 kw. At Massillon the property which is now the Massillon Electric & Gas Company had an output for the twelve months of 1912 of 1,898,374 kw.-hr. at the switchboard, with the maximum demand in the twelve months of but 764 kw. For the first nine months of 1919 the Massillon Electric & Gas Company had actual deliveries at the switchboard of 24,333,967 kw.-hr., with a maximum demand in the nine months of 9400 kw. The management estimates that the switchboard delivery of electric energy for 1919 will be in excess of 39,000,000 kw.-hr. and maximum demand 9700 kw.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Proximate Contributing Cause of Death.—Parents may recover from a power company for death of their son through electric shock, even though the company's negligence was not the sole cause of the death, provided it contributed proximately thereto. (Kribs vs. Jefferson City Light, Heat & Power Company, 215 S. W. 762.)

Assumption of Risk by Repairman.—In an action for injuries to a street railroad's repairman, who, on assurance of his foreman that it was safe, mounted a ladder resting against a trolley wire and cut a guide wire, the question whether the employee assumed the risk of a fall the Court of Appeals of Kentucky held to be for the jury. (215 S. W. 944.)

Disobedience Does Not Relieve Employer of Liability. — Where a lineman was doing his work on top of a tower carrying an electric transmission line, his contributory negligence in failing to observe a direction not to go near certain live wires did not relieve his employer from liability to make compensation for his death. (Mississippi River Power Company vs. Industrial Commission, 124 N. E. 552.)

Subrogation of Rights Against Negligent Third Person.—In an action by a workmen's compensation insurer to recover indemnity paid by it, under a policy issued to a telephone company, on account of the death of the latter's employee, brought against the power company whose negligence caused the death, the insurer's rights to recover were the same as the rights of the deceased. (Fidelity & Casualty Company vs. Cedar Valley Electric Company, 174 N. W. 709.)

Maintaining High-Tension Wire Over Telegraph Wire.—An electric company which, after the erection of a telegraph company's line, erects and maintains over and across the line of telegraph wires, or in close proximity thereto, a high-tension wire which carries a dangerous current of electricity is bound to exercise ordinary diligence in the erection and maintenance of its poles and wires so as to permit an employee of the telegraph company who ascends a pole of his company in the discharge of his regular duties to perform his work in reasonable safety; and an employee of the telegraph company, while in the exercise of ordinary care for his own protection, has the right to assume that such high-tension wires are properly placed and insulated. (Columbus Power Company versus Puckett, 100 S. E. 800.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

H. S. Brooks, who for a number of years has held the position of general construction superintendent for the American Telephone & Telegraph Company, has been appointed assistant vice-president of that company.

L. L. Ferree, superintendent of the Harrisburg (Pa.) Light & Power Company, has been made manager of the Salem (Ohio) Lighting Company. Mr. Ferree has been connected with the electrical companies of Harrisburg for sixteen years, originally being associated with the Paxtang company and going over to the Harrisburg Light & Power when that company was absorbed.

Col. W. E. Greenlaw of Eastport, Me., has been nominated to be a member of the Public Utilities Commission of Maine for a seven-year term to fill the vacancy caused by the resignation of Hon. W. B. Skelton of Lewiston. Col. Greenlaw has been mayor and postmaster of Eastport, is a former adjutant-general of Maine, and during the world war served as quartermaster of the Twenty-Sixth Division. He is at present commander of the American Legion in Maine.

Frank A. Coffin, formerly assistant sales manager of the Milwaukee (Wis.) Electric Railway & Light Company, was appointed sales manager of the company as of Dec. 1, 1919. Mr. Coffin is an engineer, and his entire experience has been in the central-station field. From 1902 to 1905 he worked in the operating department of the Commonwealth Edison Company, after which he went to the University of Illinois, graduating in 1909 with the degree of B.S. in electrical engineering. He went back to the Commonwealth Edison Company for about three years, one of which was spent on construction work at the Fisk Street and Quarry

F. A. COFFIN

Street stations, and two years were spent in the engineering department on station and substation design. In January, 1912, Mr. Coffin joined the engineering department of the Milwaukee company, where he was employed for about a year on power-plant design. He was then transferred to the sales department in an engineering capacity, and on Jan. 1, 1917, was made assistant sales manager.

Charles F. Wallace, who recently returned to Stone & Webster after a term of service in the shipbuilding industry during the war, has left Boston on a business trip to Japan, where he will investigate various hydroelectric matters on behalf of the firm.

Charles P. Bruch, until recently vice-president and director of the Postal Telegraph Company, has just been placed in charge of the interests in a large part of South America of the Marconi Wireless Telegraph Company of America and is sailing immediately for Buenos Ayres. Himself the son of a distinguished telegraph manager, Mr. Bruch has been all his life in telegraphic operation and administration, and served in the great War as a major in the signal section of the Officers' Reserve Corps, U. S. Army, also as a member of the committee on telegraphs and telephones of the Council of National Defense. Mr. Bruch is also past-president of the Magnetic Club of New York and the Ohio Society of New York, and is now the president of the Society of the United States Military Telegraph Corps. He has also been active and prominent in the affairs of various telegraphic organizations, notably the old-time Telegraphers' and Historical Society, New York Telegraphers' Aid Society, the Society of the U. S. Military Telegraph Corps, the Telegraph and Telephone Life Insurance Association, etc.

General E. J. Spencer, manager of the recently organized St. Louis Electrical Board of Trade, is a West Point graduate (1882), who, after leaving the army in 1892, returned to the service twice during national emergencies. In 1898 he was commissioned lieutenent colonel of the Third United States Volunteer Engineers for service in the Spanish-American war, and in 1917 he was commissioned colonel of engineers in the national army. He organized three regiments of engineers, the last of which, known as the Thirty-second Engineers (railway and bridge), he took over to France. Over there he was appointed first chief of staff of Base No. 2. In addition to his army service General Spencer did some important research work for what was then the Thomson-Houston Electric Company, after which he undertook considerable high-tension underground work for light and power companies in the Central West. From 1904 to the time he entered the national army General Spencer had been practicing as a consulting engineer in St. Louis. He was colonel of the first regiment of infantry, National Guard of Missouri,

BRIG.-GEN. E. J. SPENCER

and wears the uniform of that rank in the photograph, though he was promoted to brigadier general in 1913.

Obituary

Frederick A. Brainerd, secretary and vice-president of the Ingersoll-Rand Company, died on Jan. 18 in his home in Mount Vernon, N. Y., aged fifty-eight.

Henry Wilson Hodge, noted engineer, ex-New York Public Service Commissioner and lieutenant-colonel on the staff of General Pershing in France, where he was in charge of building military highways and railroads during the war, died suddenly from heart disease on Dec. 22 in his home in New York City in the fifty-fifth year of his age.

Albert Schmid, for many years associated with the Westinghouse interests as electrician and mechanical engineer, died at New York, Dec. 31. Mr. Schmid was born in Switzerland in 1858 and came to the United States in 1882 at the instance of the late George Westinghouse and was associated with the Westinghouse interests until his death. When the Westinghouse Electric Company was organized in 1885, Mr. Schmid was made its chief engineer and later, through several promotions, became general superintendent. He was recognized among all engineers as having a peculiar facility for combining beauty of design, simplicity and mechanical efficiency. The general lines of contour of the early designs of electric motors and generators produced by Mr. Schmid prevail to a large extent in the apparatus being built to-day. When the European Westinghouse electric companies were organized Mr. Westinghouse designated Mr. Schmid for important work in connection therewith, and thereafter he continued to occupy important executive positions in a number of the European Westinghouse companies.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

METER DEMAND UNFILLED EVEN WITH INCREASED PRODUCTION

Makers Can Begin Shipments of Watt-Hour Meters in Three Weeks on Orders Which Would Normally Come from Stock

Meter production is far behind the demand in spite of recent increases in productive capacity. One prominent manufacturer of watt-hour meters increased his capacity approximately 100 per cent in the early fall and hoped to be able to accumulate stocks by the end of October. He still can't begin shipment on a fair-sized order inside of three weeks. Other manufacturers, too, have increased their capacities in varying amounts, up to 100 per cent, and the demand is still unsatisfied.

It is becoming more usual now for central stations to order meters before shipments on a previous order have been completed. This overlapping of orders is a new turn in the market and shows the difficulty of accurately judging future needs and carrying anything like a fair utility stock. Heavier ordering is reported from all sections of the country because of the big volume of new houses and of newly wired old houses. One central station in the East has set approximately 6,000 meters in the last six weeks.

The smaller stations are getting nearly as big relative increases. Former orders of 100 meters at a time are being doubled. Central stations have been able to use fewer of their summer home meters for other installations this fall because more summer homes are being occupied all the year round. In the Manhattan district of New York City office building owners are requiring tenants to meter their lighting current as lighting agreements run out.

The increasing demand for 10-amp. meters is noticeable, both for new installations and for replacing 5-amp. sizes. The answer to this is found in the more general use of energy-consuming household devices and better lighting.

SHOULD PORCELAIN PACKING CHARGES BE PASSED ON?

Southern Jobbers Show Great Diversity of Opinion Concerning the Advisability of Taking a Step of This Description

Southern jobbers are discussing the advisability of passing packing charges on porcelain on to the consumer as a separate item of cost. There seems to be a considerable diversity of opinion as to the wisdom of taking such a step. Some of the jobbers who are very much opposed to such action point out that this item of cost is already added into the charges and that the consumer eventually pays the charge without being made aware of the fact. Furthermore, to add packing charges to a bill for material, especially if the consumer thinks the packing charges so added are excessive, might have a tendency to create friction between the consumer and the jobber. Incidentally such a step would offer an opportunity to unscrupulous jobbers to hold out, directly or indirectly, a cut in price by offering to absorb packing charges, especially in the face of keen competition.

On the other hand, the advocates of separate packing charges claim that the item of packing is a variable cost and therefore should be charged as a separate item in order to prevent confusion in figuring the charge on the commodity itself. They claim that it is not fair to spread the packing charge over the entire allotment of porcelain they receive, thus penalizing the large user for more than his proportionate share of the packing charges of the shipment.

It is virtually impossible to make a statement regarding the cost of such packing charges, as it varies widely, dependent upon the class of material packed, the availability of boxes, excelsior and labor, etc., and the methods and distance of transportation. It can only be arrived at by averaging the cost over a long period of time for entire shipments. A report from the South states that most jobbers have no accurate idea of what these packing charges are and consequently are adding arbitrary amounts to take care of this item.

TREND OF PRICES AFFECTED BY POLICY OF RESERVE BANK

First Increase in Discount Rate Took Money from Stock Market—Further Increases May Seriously Affect Business

A forecast of business conditions and the trend of prices during the next twelve months will depend largely upon the banking policy to be pursued by the Federal Reserve Board. Many bankers and business men believe that the extensive speculation which has been carried on this year in both stocks and commodities, and the resulting currency inflation and high prices, is largely due to the low discount rate which was maintained for as many months by the board of the Federal Reserve Bank. The board has now begun to act. It might be well for business men in the electrical industry to watch the policy and actions of the board closely and to pay some attention to the published reports from the national banks of Europe.

The board gave a warning against speculation last summer, and the prices of stocks dropped appreciably. This was only temporarily, however, and in a short time speculation was greater than ever not only in stocks but in many commodities. No action was taken until the second week in November, when the discount rate at the Federal Reserve Bank in New York was raised one-quarter of one per cent. This did not mean much in itself, but it was one step further than the warning which had been given in the summer, and the fear of what might be done caused a crash on the stock exchange.

The troubles of the stock exchange did not affect the electrical business, but if the second warning of the banks is not heeded, and more drastic action has to be taken to curb speculation not only on the stock exchange but in commodities, then business in general may be expected to feel the results. Many bankers believe that the Federal Reserve Board at Washington intends not only to restrict speculation, but also to bring about general deflation in currency and lower prices by raising the discount rates of the twelve federal reserve banks to whatever extent may be necessary. This is really raising the price of money, which means that electrical as well as other producers and consumers will not be able to borrow so much. This will result in a reduced volume of buying and lower prices would be expected to follow.

Particularly will higher money be felt in new building and in development work. In both of these the electrical manufacturer and jobber is vitally interested. Any drawback to construction work will be felt at once in the elec-

trical industry. Besides there is every reason to believe that the country is on the verge of an internal development of water-power resources. The extent to which electrical materials will be needed is apparent. More expensive money, however, will by no means be conducive to the most extensive development.

BRASS MARKET NOW IN A FLOURISHING CONDITION

Electrical Manufactures Absorbing Large Output—Prices Lower than Last Summer—Labor More Stable and Deliveries Fair

The influence of the cost of copper upon the price of brass is well illustrated by the course of the latter since midsummer, when advances in the cost of labor in the Naugatuck Valley of Connecticut failed to produce any considerable change in quotations to electrical manufacturers compared with the increases which accompanied the upward movement in copper. In a review of the conditions prevailing in the brass market published in the ELECTRICAL WORLD Aug. 30, 1919, page 493, it was pointed out that labor cost was a much less important factor in the price of brass than material cost. The following comparison of base prices of brass and brass products bears out this contention:

	Aug., 1919	Dec., 1919
Sheet metal:		
High brass	27¾	24¼
Low brass	30¾	26¼
Wire:		
High brass	27¾	24¼
Low brass	30¾	26¼
Commercial bronze	33¼	28
Rods:		
High brass	26¾	22¾
Low brass	31¼	27
Commercial bronze	33¼	29
Brazed tubes:		
Brass	39	36
Copper and commercial bronze	44¼	40¼
Copper:		
Sheets	33¼	28¼
In rolls	31¼	26¾
Drawn-copper shapes	30¾	25¾
Copper wire, bare, f. o. b. mill	26¾	22

These prices include delivery from the mills up to fifty cents per 100 lb. freight rates. They show that the reduction in the price of copper which has taken place since summer has been directly reflected in lower quotations by the brass manufacturers, while the wage scales established in the Naugatuck Valley remain generally the same. Throughout the electrical industry there is a widespread opinion that copper is not likely to go lower in price for some time, and if advances occur at a rate which indicates a rising market, there will doubtless be a flood of new orders which will overtax the facilities of the brass mills and seriously extend deliveries.

At the present, however, the needs of electrical manufacturers appear to be well cared for; *i.e.*, in the case of those who have pursued a far-sighted policy with regard to orders. The brass mills carry few stocks of material suited to electrical manufacturing requirements. Regular trade is cared for first, and it seems fair to say that recent severe shortages in sockets, for example, were not due to any large extent to brass shortage. The failure of jobbers last spring to realize that a large increase in business was almost upon them had much to do with the scarcities noted from time to time in these columns and still not wholly overcome, to put it mildly.

The brass mills are running about ten hours per day now and in some cases at night. Raw copper is plentiful, and the base price in the ingot of about 19½ cents at this writing may be contrasted with 24 cents last summer. Labor is not up to normal efficiency as yet. One of the larger mills is working about 50 per cent of its departments at night and has a total of 66,000,000 lb. of brass in process in its establishments. There is a very heavy demand for sheet copper for washing machines, and in some cases deliveries cannot be promised to new customers until next summer or early fall. Commutator copper for small motors is also in great demand, but this business does not appear to be affecting the supply of brass to manufacturers of sockets and switches. Europe has not as yet begun to purchase copper on a large scale from this country and cannot afford to do so at the current low rates of exchange.

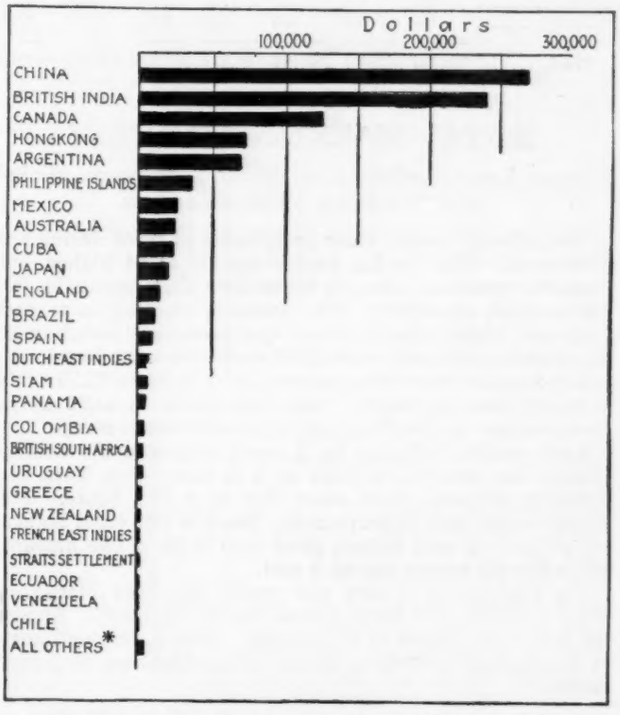
Among the different brass mills deliveries vary considerably, but in general seamless tubing is quoted around thirty-five days; sheet metal, forty-five days; brass wire, thirty to fifty days; copper wire, thirty to forty days; screw shells and socket shells, sixty days. Price guarantees are being given for the first quarter of 1920. In sum, there appears no reason for disquiet as to the supply of brass unless a heavy increase in demand should suddenly arise. Considering scarcities in many other fields, the brass market is more favorably situated than is supposed to be the case, but there seems little prospect of lower prices or quicker deliveries for months to come.

ELECTRIC FAN EXPORTS IN FIRST HALF OF YEAR

China Principal Market, Followed Closely by British India—Average Value $19, with Range Between $6 and $42

During the first six months of the current year exports of American-made electric fans amounted to $995,838. More than 50,000 fans were exported in that period, having an average value of $19.

British India, which usually is the best customer of



ELECTRIC FAN EXPORTS DURING FIRST SIX MONTHS OF 1919

American fan manufacturers, gave way during the first half of 1919 to China. Cuba, which is ordinarily among the first five, dropped to ninth place.

South America, which prior to the war purchased large numbers of fans, is still absorbing a much smaller volume of imports, Argentina leading as usual.

A considerable range of values is noticed, from as low as $6 per fan for Italy to as high as $42 per fan for Siam. The two principal markets, China and British India, both averaged $24 per fan. Canada's average was low with $12. The same figure held for Argentina. The accompanying

*All others include Belgium, France, Iceland, Italy, Bermuda, British Honduras, Honduras, Salvador, Newfoundland, Labrador, Barbados, Jamaica, Trinidad and Tobago, other British West Indies, Danish West Indies, French West Indies, Haiti, Peru, French Asia, British West Africa, French Africa and Italian Africa.

table gives a detailed summary of electric fan exports during the first half of the year. A graphical presentation is also given:

	Jan.	Feb.	Mar.	Apr.	May	June	Total
Greece	2,590	.....	250	.....	.....	747	3,587
Spain	4,503	.....	.....	.....	2,395	3,495	10,393
England	14,765	.....	.....	.....	.....	.....	14,765
Canada	4,212	4,332	37,000	11,824	14,532	54,324	126.224
Panama	2,101	716	176	144	1,788	.....	4,925
Mexico	1,665	2,407	1,661	2,701	10.500	6,001	24,935
Cuba	94	13,231	1,342	150	4,663	3,236	22,716
Dominican Republic	8,464	12,326	26,894	7,377	750	13,914	69,725
Brazil	754	4,200	3,510	714	1,240	.....	10,41
Chile	.....	429	.....	.....	470	565	1,464
Colombia	1,639	243	903	247	965	56	4,053
Ecuador	307	1,051	.....	371	.....	.....	1,729
Uruguay	.....	.....	944	2,750	.....	.....	3,694
Venezuela	1,400	205	18	.....	.....	.....	1,623
China	14,007	10,041	107,115	16,824	109,768	12,818	270,578
British India	73,385	35,286	43,470	43,674	23,024	20,243	239.582
Straits Settlement	200	450	131	50	525	846	2,202
Dutch East Indies	.....	236	8,892	118	64	415	9,725
French East Indies	286	1,367	.....	.....	342	548	2,543
Hong Kong	31,093	10,472	25,598	.....	4,175	2,328	73.666
Japan	2,221	121	2,813	80	12,326	2,790	20,351
Siam	4,446	1,280	.....	.....	.....	.....	5,726
Australia	3,892	5,300	4,826	7,928	1,153	700	23,799
New Zealand	1,132	1,339	.....	135	.....	.....	2,606
Philippine Islands	17,493	507	3,840	92	11,759	931	34,622
British South Africa	512	435	.....	.....	1,659	1,101	3,707
All others	130	400	142	422	1,357	3,471	5,922
Total	176,526	121,003	269,934	96,433	201,125	130,817	995,838

METAL MARKET SITUATION

Copper, Lead, Spelter, Zinc, Sheet, Antimony, Nickel and Tin Show Price Advances

Virtually all metals show an increase in price during the past week. The London copper market is £4 higher, but domestic producers are not permitting their prices to follow to such an extent. The domestic electrolytic market is ¼ cent higher than a week ago, quotations standing at 19 to 19.25 cents, although 19.50 cents has been found.

Copper-wire base has advanced from 21.50 to 22.25 cents a pound and copper-wire rods from 20.25 to 21.25 cents. Scrap copper is ¾ cent higher, as are the brass scraps.

Lead continues higher to 8 cents, although the outside market has received as high as 8.75 cents New York for January shipment, with more bids at a like figure. The supply shows little improvement. Sheet is 1.50 cents higher.

Spelter is ½ cent higher, sheet zinc is up a like amount, while the old scraps are up ¼ cent.

An advance of 1 cent per pound has been placed on ingot nickel by the International Nickel Company. Straits tin is 4 cents higher to 59.50 cents a pound, and antimony is ¼ cent higher to 9.87½ cents, while aluminum is ½ cent lower.

NEW YORK METAL MARKET PRICES

	Dec. 30	Jan. 6
Copper:	£ s d	£ s d
London, standard spot	116 15 0	120 0 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00 to 19.50	19.00 to 20.00
Electrolytic	18.75 to 19.00	19.00 to 19.25
Casting	18.50	19.00 to 19.25
Wire base	21.50 to 22.00	2.25
Lead, trust price	7.50	8.00
Antimony	9.62½	9.87½
Nickel, ingot	41.00 to 42.00	42.00 to 43.00
Sheet zinc, f.o.b. smelter	11.50	12.00
Spelter, spot	9.00 to 9.10	9.50 to 9.60
Tin	59.50	63.25
Aluminum, 98 to 99 per cent	32.00 to 33.00	31.50 to 32.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.00 to 17.50	17.75 to 18.25
Brass, heavy	9.75 to 10.25	10.50 to 11.00
Brass, light	7.75 to 8.00	8.50 to 8.75
Lead, heavy	6.00 to 6.25	6.75 to 7.00
Zinc, old scrap	4.75 to 5.00	5.00 to 5.25

THE WEEK
IN TRADE

FROM virtually all over the country, but particularly the East, reports show an absence of the usual midwinter lull in electrical supply buying. Inventory has interfered little with business. Stocks are badly broken in such lines as some schedule materials, loom, flexible armored conductor and conduit, boxes, low-voltage porcelain, lamp and heater cords and tableware. Pipe stocks are spotty and wire is generally available.

Price advances over the last week of December and the first week of January have been applied to flexible armored conductor and conduit, friction tape, heating appliances, lamp cords and magnet wire, single-phase motors, knife switches, porcelain tubes, some time switches and unit lighting fixtures. Further motor and pipe advances are predicted.

The outlook for 1920 is particularly good in view of building held over from 1919 and anticipated in 1920 and the amount of central-station extension predicted in some sections. Ordering far in advance shows the faith in the new year.

In the Far West business is rather dull and the rainfall light, the latter being a determining factor in next season's crops.

Building plans projected in the past week show interest in several large lofts and office buildings and a large apartment house on Manhattan Island. In addition over $7,000,000 has been appropriated for schools in New York City and over $14,000,000 for fourteen new municipal piers on Staten Island.

NEW YORK

From reports of several jobbers in the district, the usual midwinter slump in buying of electrical supplies is not going to be experienced this season. Manufacturers of many lines are not able to supply sufficient material to meet more than daily needs of the trade, and these needs are not dropping off.

A few jobbers who have completed their inventory report bigger stocks than they had a year ago, because they now have lines which did not exist at that time on account of war curtailment. Stocks are more diversified now, although badly broken in some schedule materials, flexible armored conductor, flexible non-metallic conduit, low-voltage porcelain, certain outlet boxes, lamp and heater cords and heating ware. Pipe is not in good shape in smaller sizes, but rubber-covered wire is sufficient for the time being, with mill shipments about thirty days. Air-heater stocks are good here and bad there, according to the manufacturer concerned.

During the last week of the year, and in some cases the last day, several price changes became effective. Flexible armored conductor and conduit advanced in price, ordinary friction tape went up, at least one manufacturer of heating appliances published an advance, and lamp cords and magnet wire increased. Some single-phase motor manufacturers advanced 10 per cent as late as Jan. 5. Rubber-covered wire base is averaging lower.

FLEXIBLE ARMORED CONDUCTOR.—The last of December prices advanced on sizes other than No. 14 about 10 per cent, while No. 14, two-wire, has been reported up about 7 per cent. Supply of steel strip is short, and little relief is expected in the near future. Jobbers cannot stock. They are quoting $86 to $90 on 1000-ft. lots, but a price as high as $110 has been heard.

FLEXIBLE METALLIC CONDUIT.—On 1-in. sizes and larger a change in discount and an advance in list of $1 per 100 ft. caused an advance in price of about 15 per cent the last of December. For smaller sizes a change in discount raised the price 10 to 12 per cent.

RIGID CONDUIT.—Stocks are low, and jobbers are selling ½-in. black in 5,000-ft. lots for $70 to $78.

TAPE.—An advance of 5 cents a pound on ¾-in. ordinary black friction tape was effective the last of December, bringing jobbers' prices around 40 and 45 cents.

HEATING WARE.—Effective Jan. 1, prices on table heating ware were advanced on the "Universal" line on an average about 20 per cent. Orders booked for the first half of 1920 are extremely heavy on all lines.

AIR HEATERS.—Sales have been heavy, and jobbers' stocks are extremely spotty, depending upon the manufacturer concerned.

LAMP CORDS.—The market is short and shipments are quoted around twelve to sixteen weeks. The last of December prices advanced about 10 per cent at the mills. Producers quote on silk cords when the silk is available for insulation.

MAGNET WIRE.—A 5 per cent advance was effective the last of December. Large sizes are more available than sizes around 20 and higher. Shipments are around ten weeks on these small sizes.

RUBBER-COVERED WIRE.—In 1000-ft. lots No. 14 sells for $12.50 to $13.25, while in 5,000-ft. lots the price ranges from $11.25 to $11.75. Stocks are fair. Latest reports show lower bases as follows: Four producers on 30 cents, two on 28 cents, one on 27 cents, two on 26 cents and one on 23 cents, averaging just under 28 cents.

MOTORS.—On Jan. 5 Century single-phase and polyphase motors advanced 10 per cent, while Wagner single-phase and Crocker-Wheeler fractional single-phase advanced a like amount in the last part of December.

CHICAGO

Electrical jobbers and dealers are very enthusiastic about their outlook for 1920 business. Jobbers are in general extending their forces, putting on new salesmen, and several new jobbing houses and many new retail dealers started business on the first of the year. The volume of service now demanded from electric companies has increased to such an extent that it is very difficult for the present generating stations and transmission lines to take care of it. This means a large amount of construction during 1920, some of which is already started. Chicago building permits for the week amounted to only $1,540,000. The Home and Housing Association, St. Louis, Mo., expects to have a fund of $2,000,000 available this spring for constructing homes. The aim is to have 1,000 new homes built by the end of 1920. There is a marked scarcity in Chicago of loom, armored conductor and porcelain fittings. Manufacturers of these materials are adopting more generally the price at delivery method of selling.

WIRE.—Prices have remained firm at about a 30-cent base for rubber-covered. The low cost of copper has been offset by the higher cost of labor and especially of cotton. This has caused manufacturers to change their base sizes in weatherproof wire to include from No. 0 to No. 0000, instead of No. 4 to No. 0000. The base price on weatherproof remains at about 30 cents, but this change has raised the price of wire smaller than No. 0 1½ cents to 2 cents per pound.

FLEXIBLE ARMORED CONDUCTOR.—Armored conductor is very scarce and prices are stiff. Some jobbers who lowered their price about three or four months ago have now put them up, and the average price for No. 14 two-wire per 1,000 ft. is $87.50 in 5,000-ft. lots.

NON-METALLIC FLEXIBLE CONDUIT.—This material is almost impossible to get from the factory, and no definite date of delivery is promised. Prices are stiff and net $28 to $30 per 1,000 ft. for ⅜-in. loom in lots from 1,000 ft. to 5,000 ft.

KNIFE SWITCHES.—Prices have advanced 10 to 15 per cent. Stocks are low, particularly in the smaller sizes. The net price on a 30-amp., three-pole, 250-volt fusible switch is $2 in fifty-dollar lots.

TIME SWITCHES.—Some manufacturers have increased their prices about 10 per cent. Delivery is very slow.

LIGHTING FIXTURES.—Manufacturers of ornamental lighting fixtures have in general raised prices during the last month or two. On Jan. 1 the Brascolite prices advanced 10 per cent.

CROSS-ARMS.—Cross-arms are very hard to get, and some of the makers prefer to turn out other lines of lumber products because of a greater profit. There has recently been a price increase of about 20 per cent put into effect on some cross-arms. A four-pin, 5-ft. cross-arm is now quoted at $86.50 net per 1,000 f.o.b. Chicago.

BOSTON

Business tends to increase with the turn of the year. Several price advances are noted, including a 10 per cent increase on Century motors effective Jan. 5 and corresponding readjustments in Wagner and Crocker-Wheeler motor prices within the past week or so. Armored flexible conductor is quoted higher; electric coal leaders advanced from 5 to 10 per cent Jan. 1, and snap switches, porcelain tubes and friction tape are stiffer. Stocks are spotty and especially low in socket devices. Collections are a little improved. Deliveries are somewhat better on flexible armored conductor and pull sockets. Central station business is increasing very rapidly, one central New England company adding about 1,500 hp. in motor load during December. Generating plant expansion will be a feature of 1920 on some of the important medium-sized New England systems. Electrical contractors are very busy, both industrial and residential work occupying their forces.

MOTORS.—A general advance in price is looked for, but two of the largest producers have not changed their quotations to conform to the above increases of 10 per cent. Stocks are very hard hit, especially in single-phase motors; two representative deliveries quoted are twenty and twenty-six weeks.

ARMORED FLEXIBLE CONDUCTOR.—Single-strip No. 14 is bringing $88.50 to $90 with healthy demand and scanty but gradually improving stocks.

WIRE.—Base prices rule around 24.5 cents on bare, 26 to 28 cents on weatherproof and 30 cents on rubber-covered. Smaller sizes are low in stock, but current demands are being fairly well met through incoming shipments. Prices on No. 14 rubber-covered range from $11.50 per 1000 ft. in 5,000-ft. lots to $16 in less than coil lots.

SOCKETS.—Prices are steady, with better supply reported in pulls.

RIGID CONDUIT.—Higher prices are expected, but these have not shown up notwithstanding the difficulties of securing satisfactory delivery on smaller sizes of black pipe. Box covers are hard to get, and fitting stocks are hard hit. Rigid black pipe, ½-in. size, is quoted at $83.75 per 1,000 ft. for less than 2,50[illegible] lb. lots.

TUBES.—A price advance from $7.50 to $8.50 per 1,000 in barrel lots is noted, with scarcity in supply. Porcelain is very hard to get at present.

NON-METALLIC FLEXIBLE CONDUIT.—This material brings about $30 per 1,000 ft. in the ⅜-in. size, when it can be had. The market is pretty well oversold.

METALLIC FLEXIBLE CONDUIT.—Prices are firm, double-strip ranging from list plus 15 per cent to list minus 10 per cent and single-strip from list plus 10 per cent to list minus 15 per cent, according to quantities. A severe shortage is being faced.

SNAP SWITCHES.—Discounts are being cut from the former 20 per cent basis to 17 and 15 per cent, standard packages. The incoming supply is fairly good, but stocks are not equal to the demand, by and large.

TAPE.—Prices are somewhat stiffer, and the demand has fallen off in consequence. An advance of 5 cents per pound occurred Jan. 1. Tape in 100 lb. lots, ¾-in. black, quotes around 52 cents per pound, while 1,000-lb. lots, on a yearly contract bring around 46 cents.

WATT-HOUR METERS.—Some central stations are buying for June delivery. Prices are steady, but the supply is being absorbed so fast that stocks are virtually cleaned out. A fair average delivery is given as from thirty to forty days.

APPLIANCES.—Jobbers will not be supplied to any extent until the middle of February, it is said. Business continues very active. A good supply of 660-watt radiators is reported in jobbing circles, and flat-irons are not all cleaned out. Hollow ware in general, however, is low in stock.

ATLANTA

Dec. 31 closed the greatest year that Southern jobbers have ever known. The new year finds optimism the rule, and everything indicates that the year 1920, the early part at least, will be equally good or even better. Indications in the section point to a big building year, the 1919 permits for Atlanta totaling 3,022 permits, valued at $10,442,000. Many of these permits were taken out in the last few days of 1919, throwing actual building operations into 1920. Clearings for Atlanta show a gain of $1,000,000,000 over 1918, December alone showing a gain of $100,000,000 over the same month last year.

The new year ushers in a number of new price advances on electrical commodities, the principal ones of which are as follows: Wire, 5 per cent; cross-arms, pine and fir, 20 per cent; friction tape, 10 cents per pound; flexible steel conductor and armored lamp cord, 5 per cent.

The slackening in jobbers' orders due to the inventory period has passed, and jobbers report the receipt of numbers of large orders for January shipments.

RIGID CONDUIT.—Conditions remain unchanged, stocks continuing very low, owing to slow shipments.

WIRE.—Jobbers report a brisk demand for future shipments on rubber-covered, while the demand for weatherproof continues to exceed the supply in almost all the popular sizes. Stocks of rubber-covered are fair. Jobbers are quoting prices on rubber-covered, 28 cents base; weatherproof, 29 cents base, plus 5 per cent.

LAMPS.—Jobbers report that the last few months have seen the greatest demands for lamps yet recorded. This is accounted for by the large amount of building and the general demand for more and better light. The tendency of textile mills to improve their illumination has caused a brisk demand for the large-size lamps in from 150-watt to 250-watt sizes. All stocks and shipments throughout the territory are reported good.

FLASHLIGHTS.—The heavy Christmas demand has badly depleted local holdings, and orders are being placed very generally for replenishment of stocks. This is particularly true of flashlight cases.

FLEXIBLE ARMORED CONDUCTOR.—The shortage continues, owing to poor shipments. There are very little stocks of moment in the territory, with no prospects of immediate improvement. Jobbers' prices are quoted as follows: Two-wire, 1,000 ft. to 2,500 ft., No. 14, single-strip, $99 per 1,000 ft.; $3 more is now being asked for double-strip.

FLEXIBLE NON-METALLIC CONDUIT.—Inability to supply the demand is reported by all jobbers, such shipments as are coming in being diverted to fill back orders. Prices are: ½-in., $3.60 per 100 ft. in lots of 1,000 ft. to 2,500 ft.; ⅜-in., $3.30 per 100 ft., same quantity.

CROSS-ARMS.—A price advance is registered effective Jan. 1: Washington fir, two-pin, 3-ft., less than 1,000 lineal ft., 67 cents; four-pin, 5-ft., less than 1,000 lineal ft., $1.06. Pine, two-pin, 3-ft., less than 1,000 lineal ft., 51 cents; four-pin, 5-ft., less than 1,000 lineal ft., 85 cents.

FRICTION TAPE.—This is another item registering a sharp advance on the first of the year, jobbers quoting weatherproof friction tape at 80 cents per pound in lots of 25 lb. to 100 lb., while splicing compound is quoted at 73 cents. A brisk demand is noticed in both articles, especially the weatherproof. Stocks are in fair condition.

FLEXIBLE CONDUIT.—Price has advanced 5 per cent. The new price for ½-in., in lots over 1,000 ft., is $10.29 per 100 ft.

LAMP CORD.—The steel-armored variety is quoted at an advance of 5 per cent.

SEATTLE—PORTLAND

The usual and anticipated lull in electrical jobbing and retail business succeeding heavy holiday sales finds both jobbers and retailers taking inventory and getting ready for early spring business. During the past week sales dropped to practically nothing. Building was at a standstill, shipyards and allied industrial plants, logging camps and lumber mills were closed. Indications, however, point to an immediate resumption in building on a larger scale than that of the past few months, and as soon as prevalent car shortage is overcome mills and camps will resume on a larger scale than ever before.

Steel-ship building in the Puget Sound district for the time being seems doomed. It is believed, however, that spring will bring a resumption. Unless new contracts are signed steel-ship building in Seattle will be completely finished before April 1.

Seattle's espenditure on building and construction work during 1919 exceeded that of the previous year by approximately $5,000,000, the year's figure being $15,615,000. Out of this sum $5,920,000 was spent for residences.

The Spokane territory reports that more than $3,000,000 of building has been mapped out already for completion in Spokane during 1920. The largest projected building is a one-million-dollar flour mill.

FIXTURES.—The volume of sales, which has been heavy in the Seattle district for several months past, has shown during the last two weeks a perceptible decrease. This let-up is giving both jobbers and fixture houses an opportunity to build up their stocks, which were almost depleted in certain types. At present shipments are slow. The rural demand is keeping up well considering seasonal conditions.

WASHING MACHINES.—Sales since the holiday trade have shown a marked decrease, but dealers are filling back orders from several shipments which recently arrived. Stocks are low at present but additional shipments are already en route for stock replenishment.

SAN FRANCISCO

The rainfall, so important here, has been disappointingly slow, and the amount of frozen storage available for next year will be low for the fourth year in succession. On top of this heavy frosts will seriously influence the crop and orchard production for 1920.

POLES.—Jobbers and pole firms are accumulating stocks in expectation of a year of power extensions. Local stocks were seriously strained a few days ago as the result of an almost unprecedented windstorm in the latter part of November, which, it is estimated, toppled over about 1,000 poles along the lines of various power companies in the affected area.

SCHEDULE MATERIAL.—A remarkably brisk business was done during the latter half of 1919, principally in standard lines for rush construction on apartment houses and private dwellings. Particularly in demand is a new socket attachment, like a current tap except that it provides for the insertion of a plug, and porcelain box covers to replace the exceedingly scarce steel covers. There is an increasing call for sign receptacles. Local stocks are fair. An order for 5,000 lock sockets is reported from a San Diego shipyard.

LAMP CORD.—The new regulation making the use of 1/64-in. insulation cord illegal became effective Jan. 1, and jobbers have been paring down their stocks until generally they are in a very satisfactory state, although this process has been considerably assisted by slow deliveries from the factory anyway. Fair strike of 1/32-in. cords are on hand.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Electric Auto-Engine Heater for Garage Use

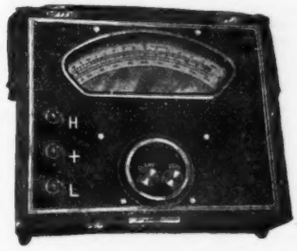
To keep automobile engines warm during normal winter weather while the car stands in the garage the Westinghouse Electric & Manufacturing

HAS NO DELICATE PARTS TO GET OUT OF ORDER

Company of East Pittsburgh, Pa., has brought out a 100-watt lamp-socket electric heater, complete with flexible cord and screw plug. It is hung by a hook on the engine, keeping both carburetor and engine warm. The heating unit of the new heater is entirely protected by a perforated sheet-metal guard.

Single-Pivot Measuring Instruments

In order to reduce friction to a minimum, only one pivot is used in the "Monopivot" galvanometers, microammeters, millivoltmeters and milliammeters which have been brought out by Herman H. Sticht & Company, 15 Park



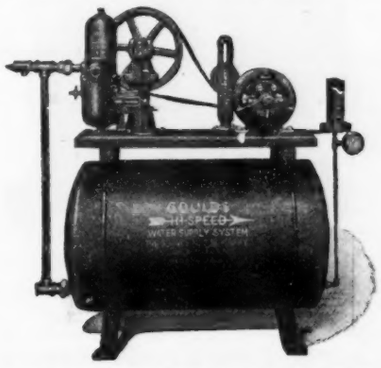
SINGLE PIVOT REDUCES FRICTION

Row, New York City. This pivot is at the center of the coil, and the movement is balanced so that the center of gravity of the whole moving system is at the point of the pivot. The jewel bearing is in the center of the spherical iron armature core.

All these instruments are equipped with zero adjusters. They are made up in two portable models and two models for wall mounting. The portable instruments, models C and D, are contained in quartered-oak cases with bayoneted hinged covers. The coils are inclosed in dust-and-fume-proof metal compartments. The wall-type instruments, models E and F, are furnished with brackets and are adjustable to any angle in the horizontal plane.

Motor-Driven Water Supply System

A new motor-driven water system, known as the "Hi-Speed Outfit," has been announced by the Goulds Manufacturing Company of Seneca Falls, N. Y., and consists of a Fig. 1695, 1¼-in. by 1¼-in. (31.8-mm. by 28.6-mm.) plunger-type pump fitted with an air cock, connected by a round belt to a ½-hp. electric motor, wound for 110-volt



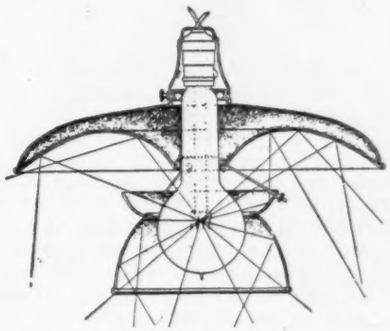
FLOATING-TYPE BELT IDLER FASTENED DIRECTLY ON WOOD BASE

or 220-volt alternating current, 110-volt or 220-volt direct current, or for 32-volt direct current. The outfit is mounted on a galvanized welded steel tank with an approximate capacity of 30 gal. (113 l.). The capacity of the outfit, which is automatic in operation, is intended to be 180 gal. (681 l.) of water an hour at 43 lb. pressure on the tank.

Glareless Metal Lighting Unit for Commercial Use

An all-steel commercial lighting unit designed to combine the vertical and horizontal lighting features of both the deep and shallow-bowl type reflectors, without cross-reflection, deep shadows or glare, has been announced by the Art Metal Manufacturing Company, East Sixty-first Street and Curtis Avenue, Cleveland, Ohio, and is known as the "Amco Super-Light."

Like the industrial lighting fixture made by this company, the new unit consists essentially of two reflectors. A gas-filled lamp is used. The open-bottom construction is used to prevent the collection of dust and dirt, and so the lamp can be replaced without taking



LIGHT DISTRIBUTION, SHOWING USE OF TWO REFLECTORS

the unit apart. To eliminate discoloration, chipping and cracking the new commercial unit has a porcelain enamel finish throughout. Attached to the upper and lower reflector as well as the canopy are chrome-gold-decorated bands.

One size of the new lighting unit is available for 150-watt and 200-watt lamps in both ceiling-attachment and chain-suspension styles.

Mica-Top Fuse Plug

The K-E mica-top fuse plug made by the Kirkman Engineering Corporation, 237 Lafayette Street, New York City, formerly had its fusible element

SCREW SHELL PREVENTED FROM TURNING

exposed on the side of the plug, in order to hold the screw shell. It has now been improved, the maker says, by the provision of a solder slot in the well of the porcelain, which not only conceals the fuse element but prevents the screw shell from turning.

Safety Guards for the High-Tension Line Workers

To keep a man working on "hot" high-voltage lines within certain bounds of safety the Bush Electric Company, 6654 Broadway, Cleveland,

PREVENT CONTACT WITH LIVE LINE

Ohio, has developed its safety guards. These are made of selected wood, which is submitted to a drying and impregnating process said to make it capable of withstanding 5000 volts to an inch. This affords protection to the worker should he, in setting or removing the guard, accidentally allow it to strike the live line.

Portable Standard-Film Motion Picture Machine

A portable motor-driven motion picture projector contained in a suitcase and using standard-width film has been brought out by the Graphoscope Development Company, 50 East Forty-second Street, New York City, and is known as the "Portmanto" model. One feature of the new machine

FIREPROOF FILM MAGAZINE SUPPORTS MOTOR, MECHANISM AND LAMP

pointed out by the maker is that it employs a lateral projection which removes the rays of light and heat from the head and allows both reels of film to be placed in one metal magazine below any possible source of fire and projected by a set of fire rollers.

The light source employed by the projector is a 350-watt incandescent lamp, and a $\frac{1}{12}$ hp. electric motor is the driving mechanism.

Full Magnet-Type, D. C. Controller for Elevator Service

For use with electric elevator motors the Warner Elevator Manufacturing Company of Cincinnati, Ohio, has brought out its type BA full-magnet direct-current controller.

The main switches are located on the controller's lower panel, while the accelerating and high-speed magnets are on the upper panel. Three of the magnets on the lower panel operate for each direction and the direction magnets are mechanically interlocked. With the new controller the field circuit is never opened until after the motor has been disconnected from the line. The accelerating magnets are operated successively by B. E. M. F. The contacts

FIELD CIRCUIT NOT OPENED UNTIL MOTOR IS DISCONNECTED FROM LINE

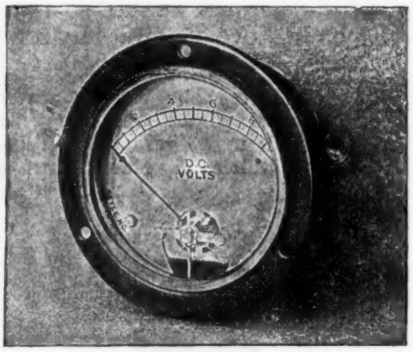
are of the rolling butt type, except the control and high-speed contacts, which are of silver.

Miniature Electrical Measuring Instruments

With an over-all diameter of $2\frac{9}{16}$ in. (40 mm.) and a weight of but 4 oz. (0.11 kg.), miniature voltmeters and ammeters have been developed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., for use on small panels where economy of space is necessary. The new type of instrument is especially intended for measuring small direct currents, such as the filament and plate currents of radio-communication sets, or those in connection with farm-lighting and other small charging and lighting sets, or in use with dental and electro-medical work.

To support the cylindrical core and movable element between the pole pieces of the magnet, use is made of two simple bronze alloy punchings securely fastened to either side of the pole pieces. Insulation of the small aluminum frame which carries the coil of the movable element is by oxidation. Moreover, the base of the pivot support is elongated and clinched around either side of the aluminum frame of the movable coil.

By combining the new millivoltmeter



FLUSH-TYPE DIRECT-CURRENT VOLTMETER

with a non-inductive heater and thermocouple it is said to be made suitable for the measurement of high-frequency alternating currents such as are encountered in radio work. The same instrument can also be operated on alternating-current circuits of commercial frequency, it is stated, provided that they are not subjected to overloads.

These instruments can be furnished for mounting with the face flush with the panel, or for projection. They are arranged for rear connection. The standard finish is white dial, nickel bezel ring and black marine case, but black dial instruments can also be obtained.

Protective Combinations for Farm Service

To meet the requirements of farm service from transmission and distribution lines, as well as other moderate capacity installations, Schweitzer & Conrad, Inc., of 4435 Ravenswood Avenue, Chicago, have placed on the market their type XW protective combinations. These are furnished for voltages up to 25,000 and consist of an adjustable horn-gap arrester, disconnecting switch, choke coil and fuse mounting. The arrester is furnished with a resistance in the ground circuit. The resistance unit is inclosed in a "Bakelite" tube provided with ferrules at both ends which fit in bronze clips so that replacements can be made if necessary without tools. When preferred, the arrester can be furnished with a fuse instead of a resistance unit in the ground circuit. The series fuse will fit in the clips provided for the resistance unit. The disconnecting switch is provided with combination blade guides and spring lock to prevent the switch from opening because of vibration. The long-turn choke coil is stated to be of liberal carrying capac-

ity, while the fuse is held at an angle of 45 deg., so that it can be easily removed or replaced. Standard "S. & C." fuses are regularly furnished.

One feature of these combinations is the use of corrugated insulators for outdoor service. The arrangement of these special insulators is such that their corrugations which support the live parts are in all cases vertical. The corrugations of the insulator supporting the grounded horn and resistance are horizontal, because such parts are normally grounded.

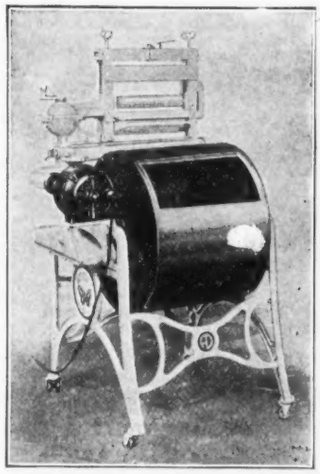
The protective combinations rated at 7500 volts are mounted on one cross-arm, while those rated at 15,000 volts and 25,000 volts are installed on two cross-arms. In all cases only two bolts are necessary to fasten the equipment to the cross-arms.

Electric Phonograph With Suspended Motor

In order to eliminate undesirable vibration a suspended electric motor is used in the "Kurtzmann-Unique" phonograph now being manufactured by Louis S. Kurtzmann of 630 Main Street, Buffalo, N. Y. This motor is of the universal type and is designed to be noiseless. On the phonograph is an electric stop which automatically stops the motor when the end of the record is reached. Mounted on the top of the phonograph there is also an electric lamp to aid in operating the machine when the light of the room is not sufficient.

Electrically Operated Washing Machine

A washing machine driven by an electric motor and designed to combine the advantages of both cylinder and oscillating type machines has been



CLOTHES ARE IN TURN LIFTED, SOUSED AND FLUSHED

placed on the market by the Albaugh Dover Company of Chicago and is known as the "Butterfly." Efforts have been made to simplfy the mechanism and reduce the number of parts.

Electric Arc Color-Testing Instrument

In the "Fade-ometer" an electrical color-testing instrument manufactured by the Atlas Electric Devices Company, 126 South Clinton Street, Chicago, the fading effect of sunlight is standardized and reproduced for testing the permanency of colors in textiles, wall papers, coloring materials, etc. The new device consists of an arc using special electrodes and incased in two telescopic sheet-steel cylinders, the whole being mounted on a stand. The instrument, which may be used on either direct or alternating current, is said to consume about 2800 watts and the life of the electrodes is said to be about twenty hours.

Automatic mechanism is provided to maintain the arc constant during the

COLOR-TESTING INSTRUMENT WITH SAMPLE HOLDING SECTION RAISED

full life of the electrodes, the regular test period for samples being considered twenty hours. Provision is made for testing forty samples at once. Part of each sample is covered and part is exposed to the light so that comparisons can be made between the tested and untested portions of the samples which are under inspection.

Coated Welding Electrode

A new-type coated electrode has been brought out by the Electric Arc Cutting and Welding Company, 222 Halsey Street, Newark, N. J., which states that it is not a completely inert covered electrode holding the arc within a sleeve and covering the deposited metal with slag, but an electrode which has chemicals in its coating to attack the oxygen and hydrogen of the air with a greater chemical affinity than steel at the welding temperature, so that the steel is saved from the weakening influences of these two elements both by the action of the chemicals and the enveloping of the arc in the outwardly moving gases of the oxygen and nitrogen combined.

Moreover, as a result of this gasifying action, it is said that no brushing, chipping or cleaning is necessary with the new electrode since the successive layers which are added show no inclusion of dross.

Electric Compound-Melting Pot

An electrically heated melting pot for melting battery compound and other compositions of a like nature in garages, repair shops and other businesses, which includes the manufacturing and repair of electric batteries, has been recently developed by the General Electric Company of Schenectady, N. Y.

The new pot has a 4-qt. (3.7-l.) capacity, is portable and has a bail to facilitate handling. Around the top of the pot is a flange which extends over the inside to prevent boiling over. The inner edge of this flange also acts as a lip for scraping the compound from the ladle. The heat is generated by a three-heat cartridge type unit which is inserted in a slot at the bottom of the pot and is regulated by a three-point plug switch. A uniform, well-distributed heat is said to be assured, and there is no danger of fire from overheating or of cooling from insufficient heat during the temporary absence of the operator.

NOTES ON RECENT APPLIANCES

Inclosed Commercial Lighting Units

The Reflectolyte Company, 910 Pine Street, St. Louis, Mo., is making its "Supreme Reflectolytes" in 75-watt to 500-watt sizes and in styles to harmonize with decorative schemes of various descriptions.

Linen Shades for Individual Lamp Bulbs

J. A. Whaley & Company, 118 Fifth Avenue, New York City, are making "Kno-Glair" pleated linen electric light shades which have recently been approved by the Underwriters' Laboratorires.

Motor-Generator Set for Meter Testing

Roth Brothers & Company, 1400 West Adams Street, Chicago, have placed on the market a three-unit motor-generator set for use in meter-testing laboratories and for other alternating-current testing.

Portable Radiant Electric Heater

The No. 7 radiant electric heater made by the Majestic Electric Development Company of 656 Howard Street, San Francisco, and 1205 Allegheny Avenue, Philadelphia, now has an improved easily removable wire guard and a locking swivel permitting the reflector to direct the heat in any direction.

Manufacturers' Activities

MANNING, BOWMAN & COMPANY will enlarge its nickel and silver plant at Meriden, Conn.

THE SPRAGUE ELECTRIC WORKS of the General Electric Company, Bloomfield, N. J., has broken ground for the construction of a new two-story addition to its plant, estimated to cost about $40,000.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Conn., has completed plans for the construction of a new four-story addition to its plant, for increased capacity. The structure will be about 60 ft. by 218 ft. and is estimated to cost $120,000.

LYNTON T. BLOCK & COMPANY, operating the Utilities Indemnity & Fire Exchanges and the Employers' Indemnity Corporation, has moved to new quarters on the second floor of the Chamber of Commerce Building, Broadway and Locust Street, St. Louis, Mo.

THE WHEELER GREEN ELECTRIC COMPANY, Rochester, N. Y., manufacturer of electric motors, etc., has completed arrangements for the erection of a new addition to its plant, about 40 ft. by 40 ft., for increased capacity. The structure is estimated to cost about $19,000.

THE APPLETON ELECTRIC COMPANY, Chicago, is erecting a new plant which will give it double the present space and will result in increased production. The building

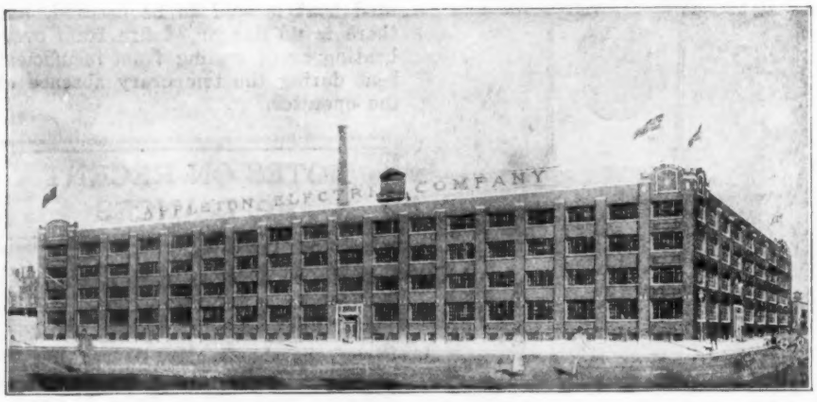
SANFORD, RILEY STOKER COMPANY is to build a factoy of initial working area of 30,000 sq.ft. at Worcester, Mass.

THE STANLEY INSULATING COMPANY, Greenfield, Mass., has prepared plans for the construction of a new addition to its plant, for increased capacity. The structure is estimated to cost $30,000.

THE CHICAGO ELECTRIC MANUFACTURING COMPANY is erecting a new $75,000 two-story factory covering 100 ft. x 135 ft. of ground on the site of the old offices at the corner of Twenty-eighth and Halstead Streets, Chicago, Ill.

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, N. Y., manufacturer of pumping machinery, has completed negotiations for the acquirement of the seven-story building, about 25 ft. by 152 ft., now occupied by the company, at 19 Park Place, and extending through to 16 Murray Street, New York City.

THE ELECTRIC SALES & ENGINEERING COMPANY has been organized at 813 Prospect Avenue, Cleveland, Ohio, to handle electrical equipment and supply engineering service. Robert P. Burrows, formerly in charge of the commercial section, engineering department, of the National Lamp Works of the General Electric Company, is sales engineer and will be in charge of all commercial activities of the company.



APPLETON ELECTRIC COMPANY'S NEW PLANT

is to be a four-story and basement structure and will cover an area of over 45,000 sq.ft. It will provide 140,000 sq.ft. of floor space, and the entire plant is to be equipped with additional new machinery. The building of this large plant at Pauling and Wellington Streets is indicative of the company's optimistic view of the future.

THE CURTIS & MYERS ELECTRIC COMPANY, electrical contracting engineers, announces the opening of its new store at 192 Pipestone Street, Benton Harbor, Mich., with a complete line of motor and factory apparatus, electrical eppliances, fixtures and housewiring materials. Messrs. Curtis and Myers were formerly with the Benton Harbor-St. Joe Railway & Light Company.

THE BLACK & DECKER MANUFACTURING COMPANY has opened an additional office on the Pacific Coast, at 201 Maynard Building, Seattle, Wash. This office is in charge of A. E. Nordwall, who will have charge of the distribution of Black & Decker products in the State of Washington, working under the direction of the main Pacific Coast office in San Francisco.

LINK-BELT COMPANY, CHICAGO, ILL., announces an addition to its Belmont foundry at Indianapolis, Ind. The extension virtually consists of completing two new furnace buildings, but for the present installing only one furnace of 15-ton capacity instead of 10-ton, the capacity of the present furnaces. The company is also purchasing the necessary machinery, such as rolling mills, sand blast and other foundry equipment needed to take of the additional capacity. The building will be about 70 ft. wide by 400 ft., and when finished will complete the foundry as originally laid out. These additions are being made to give better service.

TOWLE & CALHOUN is the name of the company recently formed in Grand Rapids, Mich., by Joseph H. Towle and T. A. Calhoun to distribute the Willys farm light throughout western Michigan. Mr. Towle was formerly with the Railway Improvement Company, New York City, the People's Railway Company, Dayton, Ohio, and the Springfield (Ohio) Railway Company.

F. S. MONTGOMERY, for the past six years advertising manager of the National Metal Molding Company, Pittsburgh, Pa., and prior to that for several years district manager in charge of the Atlanta office of the same company, tendered his resignation which took effect Dec. 31, since which date he has been associated with the Ivan B. Nordhem Company, outdoor advertising, 8 West Fortieth Street, New York City. Mr. Montgomery's successor has not been announced.

NEW X-RAY SELLING PLAN — The National X-Ray Reflector Company, Chicago, put into effect on the first of the year, a revised plan for distributing X-ray reflectors. Previously the manufacturers had filled all orders direct when placed direct, whether from jobber, central station, isolated plant or consumer, on a trade protection differential. Now, however, the company states, all products in the direct-lighting group both for commercial and industrial work will be handled solely through X-ray electrical supply jobbers, except in New York and Chicago where large local X-ray sales organizations exist. The products that are used for indirect lighting, being largely in the nature of a "chandelier" line, will continue to be marketed through "chandelier" outlets, distinctly and positively separated from the direct-lighting line and at one price to any legitimate member of the electrical trade.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY will make an addition to its East Springfield factory at an estimated outlay of $150,000.

THE KITSEE BATTERY COMPANY, 62 North Main Street, Wilkes-Barre, Pa., has had plans prepared for the construction of a new one-story addition to its plant.

THE GENERAL ELECTRIC COMPANY has awarded contract for the construction of a new four-story addition to its plant on Boyd Street, Newark, N. J., about 60 ft. by 80 ft., which will cost $66,000.

THE VICTORY BATTERY COMPANY, 30 West Houston Street, New York City, has filed notice with the Secretary of State of an increase in its capitalization from $20,000 to $30,000 to provide for general business expansion.

THE ARROW ELECTRIC COMPANY, Hartford, Conn., has arranged for the purchase of property extending from Hawthorn Street to the New Haven Railroad, adjoining its present works. It is understood that the site will be used for future expansion.

THE WILSON-MAEULEN COMPANY, 781 East 142d Street, New York City, manufacturer of pyrometers and other kindred equipment, has filed plans and awarded contract for the erection of the proposed new three-story plant at St. Mary's Street and Concord Avenue, for increased capacity.

THE H. W. JOHNS-MANVILLE COMPANY announces the removal of its Des Moines offices to more modern quarters at 213 Ninth Street on Jan. 2. W. B. Roberts, Des Moines manager, says that the new location will give him better facilities than ever for serving Iowa with asbestos and magnesia, electrical and automotive equipment and allied Johns-Manville products.

THE AMERICAN LAVA COMPANY, Chattanooga, Tenn., manufacturer of electrical insulation and specialties, announces through Paul J. Kruesi, president, that Capt. John Kruesi, formerly of the Detroit Edison Company, has returned from France and will have general management of the Lava company. He is also connected with the Southern Ferro Alloys Company, electric furnace manufacturer of steel alloys, and the Chattanooga Electro Metals Company, Chattanooga, Tenn.

Supply Jobbers' Notes

JOHN E. COUSINS, for the past twenty-five years with the Pettingell-Andrews Company, Boston, Mass., has been appointed assistant general manager of the company. Mr. Cousins is widely known throughout the New England electrical trade, and in his new work he will have direct charge of the physical stock and equipment of the organization.

THE CENTRAL ELECTRIC COMPANY, 320 South Wells Street, Chicago, jobber and wholesaler, has opened a new retail store, the Central Electric Shop, 302 West Jackson Boulevard. It has a showroom for displaying decorative lamps and household appliances and fixtures. Contractors' material will still be handled by the company's other store. Herbert Hazletine will be the manager directly in charge under H. D. Olsen, retail manager of the parent company.

THE WESTERN ELECTRIC COMPANY'S Atlanta office announces the closing of a lease for additional quarters required to handle its growing business in this district. The new building, which will be located in the uptown business section, will contain approximately 50,000 square feet of floor space and will be five stories in height. The first three floors will be used for the warehousing of electrical supplies, while the two top floors will be devoted to office use. The company expects to get into the new quarters about June 1, 1920.

SOUTHERN TIER ELECTRICAL SUPPLY COMPANY recently opened an electrical supply jobbing and retail house at 173 Washington Street, Binghamton, N. Y. Edwin C. Wehle is president and Albert H. Hyle is secretary and treasurer. The former was a salesman and the later assistant treasurer of the Mohawk Electrical Supply Company of Syracuse, N. Y. The capitalization is $35,000. About 13,000 sq. ft. of floor space is occupied for warehouse, offices and store. As soon as the lease expires ,the company announces, it will discontinue its retail sales, which embrace only 16 per cent of its business, and sell at wholesale only, carrying out its belief as to the function of the electrical jobber.

Foreign Trade Notes

ELECTRICAL SUPPLIES FOR CZECHO-SLOVAKIA.—According to a British trade representative at Prague, electric lamps, generators, transformer parts and watt-hour meters are urgently required in Czecho-Slovakia. Among the articles for which import licenses are granted are electric bulbs, copper and vulcanite goods.

SPANISH REGULATION IN REGARD TO ELECTRICAL INSTALLATIONS.—From Trade Commissioner P. S. Smith the Bureau of Foreign and Domestic Commerce has received two copies of a pamphlet (No. 40,823) containing a set of rules and regulations in regard to electrical installations, provisionally approved and recommended by the Permanent Spanish Electrical Committee for immediate application, subpect to such modifications as may be dictated by further study and practice. These regulations apply only to those electrical installations the operation of which may affect the safety of the public and persons obliged to work in close contact with live currents.

SOUTH AMERICAN INDUSTRIAL INVESTIGATION—P. S. Smith, trade commissioner of the Bureau of Foreign and Domestic Commerce, will sail for South America the latter part of January to study the South American markets for industrial supplies. Mr. Smith during the past year has conducted investigations of the electrical goods markets in Spain and South American countries. Before leaving this country Mr. Smith will confer with manufacturers of electrical appliances and machinery accessories with the idea of cooperating with them. He was scheduled to meet manufacturers in Boston Jan. 8, 9 and 10, and he will meet manufacturers in Philadelphia Jan. 15 and 16, and in New York from Jan. 19 to the date of sailing. Mr. Smith will sail for Buenos Aires on the Vestris the latter part of this month or the early part of February.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A civil engineer in Sweden (No. 31,592) desires to secure an agency for the sale of electrical apparatus.

A business man in Canada (No. 31,563) desires to act as manufacturers' agent for the sale in Canada of electrical specialties.

An electrical engineer in Spain (No. 31,583) desires to secure an agency for the sale in southern Spain of electrical goods, appliances and machinery.

A purchasing agent of firms in France (No. 31,561) desires to get in touch with manufacturers of electric lamps, electrical accessories for house lighting, etc.

The General Import Agency, El. Moustacas & Company, Eski Voevoda, No. 98, Galata, Constantinople, Turkey, is interested in the importation of electrical articles.

A firm of importers in the Netherlands (No. 31,590) desires to purchase or secure an agency for the sale of automobile accessories, especially electric light apparatus, combined or not combined with electric starter.

A firm of importers and general commission merchants in India (No. 31,542) desires to represent manufacturers of electrical fittings and accessories, generators and motors.

A representative of American exporters (No. 31,593) established in Denmark, desires to take over the agency of several additional lines of electrical equipment for sale in the Scandinavian countries. Finland, Poland, Letland, Esthonia and Russia.

I. S. Poulsen, member of the Norwegian industrial import house of Bergsvik & Poulsen, is in the United States for a short time to secure agencies in Norway for different kinds of American electrical products, especially alternators, direct-current generators, motors, transformers, electrical supplies, electrical cable, all sizes of rubber-covered wire, bare wire and copper bars. While he is in the United States Mr. Poulsen may be reached by mail at 214 North Seventh Street, Newark, N. J.

Trade Publications

REFLECTORS.—Harvey Hubbell, Inc., of Bridgeport, Conn. is circulating a mailing folder on industrial lighting reflectors.

GLASSWARE.—The Macbeth-Evans Glass Company, Pittsburgh, Pa., has issued an illustrated folder on its "Alba" light, No. 5350.

CURRENT TAP.—Harvey Hubbell, Inc. of Bridgeport, Conn. has prepared circular No. 185 about the No. 6700 "Hubbell" current tap.

STEEL PIN.—The new "Pierce Presteel" pin is the subject of a folder being circulated by Hubbard and Company of Pittsburgh, Pa.

OIL ENGINES.—The Allis-Chalmers Manufacturing Company of Milwaukee, Wis., has issued bulletin 1532-A on Diesel type oil engines.

SHOPS.—Westinghouse, Church, Kerr & Company, 37 Wall Street, New York City, has issued a folder showing some of the shops it has built.

PYROMETERS.—The Cleveland Instrument Company of Cleveland, Ohio has published bulletin No. 40 covering its resistance pyrometers.

HYDRAULIC TURBINES.—Booklet "B" has been issued by the Trump Manufacturing Company, of Springfield, Ohio, and covers its hydraulic turbines.

PLUGS.—An illustrated folder has been issued by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis. on its new swivel attachment plug.

MOTORS.—Bulletin No. 105 is being circulated by the U. S. Electrical Manufacturing Company, Los Angeles, Cal., to tell about its electric motors.

REFLECTORS.—Bulletin Nos. 16-14 on reflectors for industrial lighting, standard dome type, has been isued by Harvey Hubbell, Inc., of Bridgeport, Conn.

TRANSFORMERS.—The Packard Electric Company, of Warren, Ohio, has issued bulletin No. 200, dated October 1919, about its distribution transformers.

ELECTROMETER.—The Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J., describes its "Quadrant Electrometer" in bulletin No. 8.

TESTING DEVICES.—The Western Electro-Mechanical Company of Oakland Cal., has issued a booklet describing its load and meter testing equipment.

BALL BEARINGS.—The Gurney Ball Bearing Company of Jamestown, N. Y., has issued an engineering bulletin giving uses of ball bearing in machine design.

LIGHTING PLANTS.—The Julius Andrae & Company, of Milwaukee, Wis., have issued catalog No. 10 covering lighting plants and house-wiring accessories.

FIRE ALARMS.—The Interstate Machine Products Company of Rochester, N. Y., has issued bulletin No. 500, describing its "Sterling" electric siren fire alarm, Model M.

TRANSFORMERS.—Bulletin No. 202 on series regulating transformers for series street lighting is being distributed by the Packard Electric Company, Warren, Ohio.

DRILL PRESS.—The High Speed Hammer Company of Rochester, N. Y. has issued a folder on its high speed, ball bearing, motor-driven, bench drill press.

LAMP GUARDS.—Various types of lamp guards are illustrated and described in a mailing folder now being circulated by Harvey-Hubbell, Inc., of Bridgeport, Conn.

METERS.—The Rawson Electrical Instrument Company, of Cambridge, Mass., describes its type 501 portable single pivot meters in bulletin No. 1 recently published.

BAFFLES.—One-piece permanent baffles for water-tube boilers are covered in a folder which has been published by the Betson Plastic Fire Brick Company of Rome, N. Y.

HOME LIGHTING PLANTS.—The new "Jasco" country home lighting plant is described in a new booklet issued by the Julius Andrae & Sons Company, of Milwaukee, Wis.

NITRATE PLANT NO. 1.—The J. G. White Engineering Corporation, 43 Exchange Place, New York City, has issued a booklet telling about the construction of Nitrate No. 1.

CRANES.—The Wellman-Seaver-Morgan Company of Cleveland, Ohio, has issued bulletin No. 38 entitled "Mechanical Handling of Cargoes."

STOKERS.—"Coal" is the title of a thirty-one-page booklet which the Under-Feed Stoker Company of America, Book Building, Detroit, Mich., has issued. This contains much interesting information regarding coal from various geographical sections of the country.

GATE VALVES.—"Electrical Operation of Gate Valves" is the title of a booklet being distributed by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis., and New York City, and contains an address given by Peter Payne Dean before the Metropolitian Section of the American Society of Mechanical Engineers.

New Incorporations

THE KING ELECTRIC MANUFACTURING COMPANY of Tonawanda, N. Y., has been incorporated by L. Smith, B. Kibler and V. F. King. The company is capitalized at $25,000 and proposes to manufacture electrical equipment.

THE OAK RIDGE (IND.) ELECTRIC COMPANY has been incorporated with a capital stock of $3,000 by M. D. Johnson, Iva S. Johnson and Oscar Moffit. The company proposes to supply electricity for lamps, heaters and motors in Oak Ridge.

THE PORTVILLE (N. Y.) UTILITY COMPANY has been incorporated by G. L. Verguson, M. J. McCary and E. C. Nagel of Portville, N. Y. The company is capitalized at $50,000 and proposes to generate and distribute electricity for lamps, heaters and motors.

THE STANDER-LINDENBAUM COMPANY of New York, N. Y., has been incorporated with a capital stock of $20,000 to manufacture and deal in gas and electric fixtures. The incorporators are: P. Lindenbaum, B. and E. Stander, 819 Hunts Point Avenue, Bronx, New York City.

THE PEOPLE'S LIGHT & POWER COMPANY of Woodstock, Me., has been organized with a capital stock of $10,000 to supply electricity for lighting the towns of Woodstock and Greenwood. Mark C. Allen is president; Thomas W. Gordon, treasurer, and Ned I. Swan, clerk, all of Woodstock.

THE ENDURANCE BATTERY CORPORATION of New York, N. Y., has been incorporated with a capital stock of $25,000 by J. H. Sweiback, 1239 Simpson Street; R. Guinzburg, Flushing, and A. G. Meinecke, 3920 Broadway, New York City. The company proposes to manufacture storage batteries.

THE HADGES & McLAIN COMPANY of New York, N. Y., has been incorporated with a capital stock of $100,000 by E. Hadges, H. E. McLain and W. Loomer, 652 Amsterdam Avenue, New York City. The company is capitalized at $100,000 and proposes to manufacture supplies and electrical devices.

THE ELGIN MANUFACTURING & PLATING COMPANY, 3 Lexington Street, Baltimore, Md., has been incorporated with a capital stock of $100,000 by Edward W. Haydon, Albert A. Ross and E. K. Ross. The company proposes to manufacture electric flashlights, carbide lamps and novelties and to do electroplating.

THE AEREX MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 to do a general mechanical and electrical engineering business. The incorporators are: F. R. Hansell, E. M. MacFarland and J. Vernon Pimm of Wilmington, Del.

THE CHARLES F. L. GOAD ENGINEERING COMPANY of Toronto, Ont., Can., has been incorporated by Goldwin L. Smith, 2 Wellington Street, East; Thomas B. Richardson, John R. Cartwright and others. The company is capitalized at $300,000 and proposes to manufacture electrical equipment, automobile supplies, etc.

THE RANWOOD MANUFACTURING CORPORATION of New York, N. Y., has been incorporated by C. A. Wolf, 130 Fulton Street, Brooklyn; L. B. Morehouse, 132 Nassau Street, and J. B. Greene, 2 Rector Street, New York City. The company is capitalized at $200,000 and proposes to do electrical work and a general mechanical engineering business.

New England States

MANCHESTER, N. H.—The Amoskeag Manufacturing Company is planning to erect a new power house at Amoskeag Falls, to cost about $500,000.

FALL RIVER, MASS.—Arrangements are being made by the American Thread Company for extensive improvements and additions to its plant, including the reconstruction of its power facilities and the erection of a large boiler plant.

GLOUCESTER, MASS.—Arrangements are beng made by the General Electric Company of Schenectady for the establishment of a new plant in a number of buildings recently acquired. The proposed work, it is understood, will specialize in armature-winding. The company is also planning to erect a new drop forge plant on property recently acquired on the Annisquam River, Boston.

MEDFORD, MASS.—Plans have been filed by the Warner & Childs Company, 15 Winchester Street, for the construction of a new power plant to be used in connection with an addition to its plant.

NEW BEDFORD, MASS.—Preliminary steps have been taken by the New Bedford Gas & Electric Company for an addition (60 ft.) to its Cannon Street power house, in which a 20,000-kw. generating unit will be installed. Contract has been awarded to the Stone & Webster Engineering Corporation of Boston, Mass.

SPRINGFIELD, MASS.—Arrangements have been completed by the Cheney-Bigelow Wire Works for the erection of an addition to its plant.

NEWPORT, R. I.—Considerable electrical equipment will be required in connection with the proposed new laundry building at the local naval station, Specification 4081, by the Bureau of Yards & Docks, Navy Department, Washington, D. C. The cost is estimated at about $60,000.

Middle Atlantic States

AVON, N. Y.—Notice has been filed with the Secretary of State by the Livingston-Niagara Power Company of an increase in capital stock to $150,000.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company contemplates extensions and improvements to its plant, including the installation of a new turbine unit, during the coming year.

BINGHAMTON, N. Y.—Plans have been prepared by the State Hospital Commission for the installation of a new soot blower equipment at the power plant of the Binghamton State Hospital. Bids will be called at an early date. L. F. Pilcher, Capitol, Albany, is state architect.

GLENS FALLS, N. Y.—The Public Service Commission has authorized the Kanes Falls Electric Company of Glens Falls to transfer its property to the Adirondack Electric Power Corporation. The consideration is $125,000. The Adirondack Electric Power Company which is to be consolidated into the Mohawk Edison Company of Schenectady is to acquire the capital stock of the Kanes Falls Company, and the Mohawk Edison Company is to issue bonds to take over property and to assume the outstanding indebtedness of the Kanes Falls company.

LUDLOWVILLE, N. Y.—Contract has been awarded by the International Salt Company, 2 Rector Street, New York City, for the erection of a large steam power plant at its local plant, to cost with equipment about $250,000, to the R. H. Beaumont Company, 315 Arch Street, Philadelphia, Pa.

NEW YORK, N. Y.—The Western Union Telegraph Company contemplates an addition to its building at the corner of Broadway and Dey Street, to cost about $5,000,000.

NORTH TONAWANDA, N. Y.—Arrangements, it is understood, are being made by the Tonawanda Power Company for extensions to its plant and system, to cost about $200,000.

THIELLS, N. Y.—Bids will be received by F. A. Vanderlip, president board of managers, Letchworth Village, 7 Wall Street, New York City, until Jan. 15, for construction of storehouse, bakery, refrigerating plant and additional refrigeration equipment at Letchworth Village. L. F. Pilcher, Capitol, Albany, is architect.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., has petitioned the Public Service Commission for permission to extend its system to Clifton and for approval of a franchise granted by that town.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEWARK, N. J.—Plans are being prepared by Lockwood, Greene & Company, architects and engineers, 101 Park Avenue, New York, N. Y., for construction of the power house of the Celluloid Company, 290 Ferry Street, to cost about $100,000.

NEWARK, N. J.—Plans are being prepared by the Arthur Emmerich Company, which operates a silk throwing mill, for the construction of a three-story electric power plant to supply power for its proposed new plant, to be located on Norfolk Street, which will be equipped with electric motor driven machinery.

PERTH AMBOY, N. J.—The local power house of the Public Service Electric Company was damaged by fire on Jan. 2, causing a loss of about $50,000.

RUTHERFORD, N. J.—Plans are being prepared by the Braender Tire Company, 32 Broadway, New York, N. Y., for the erection of a new power plant at its local works. Andrew Kidd, Jr., 95 Liberty Street, New York, N. Y., is engineer.

TRENTON, N. J.—Plans are being prepared for the construction of a power plant to cost between $9,000 and $10,000, in connection with the proposed new local plant of the H. R. Mallinson Company, 136 Madison Avenue, New York, N. Y., to be located on Parker Avenue. The company has recently purchased the former plant of the Reeves-Cubberly Engine Company, which it is remodeling and will equip with silk manufacturing machinery. The plant will be operated by electricity.

TRENTON, N. J.—Plans have been prepared by the American Bridge Company, 30 Church Street, New York, N. Y., for extensive additions and improvements to its plant, to cost about $1,500,000. The proposed work will include a new main building, templet shop, and other buildings. Two new 200-ft. crane runways will be installed, and the equipment will include electrically-operated traveling cranes, motors, and other electrical apparatus, etc.

WEEHAWKEN, N. J.—Contract has been awarded by the Independent Lamp & Wire Works, 538 Gregory Avenue, for the erection of a new building on Gregory Avenue to the Irvington Lumber & Door Company, 739 Broad Street, Newark. The company manufactures tungsten lamps and other electrical products.

WHARTON, N. J.—Extensions and improvements are contemplated at the plant of the Replogle Steel Company, formerly operated under the name of the Wharton Steel Company, including the construction of new blast furnaces, a new electrically-operated ore bridge, the installation of coke ovens, a new steel finishing plant and sintering works. H. M. Roche is consulting engineer.

AMBLER, PA.—Plans are under consideration by the Philadelphia Suburban Gas & Electric Company for the erection of a new substation, 25 ft. x 50 ft., in Ambler.

BETHLEHEM, PA.—The city of Bethlehem has signed a contract with the Central Station Equipment Company of New York, N. Y., for the installation of an ornamental lighting system, covering 5 miles of streets, maintained by underground wires, in the business section of the city. The cost is estimated at about $100,000.

EPHRATA, PA.—The Tri-County Electric Company contemplates the installation of 750 kva. in transformers, in units of 250-kva., at its main transformer station at Blue Ball, and also the erection of 6 miles of 6,600-volt transmission lines. G. L. Nies of Ephrata is president.

ORRTANNA, PA.—The Orrtanna Electric Light & Power Company is considering the installation of new equipment in its plant, including a 100-hp. suction gas engine, a new gas engine, and may also purchase 100 chestnut poles and 4 miles of No. 8 copper wire and 12 General Electric I-14, 5-amp., meters for 60-cycle, 110-volt service. Nothing definite has been decided upon. S. Z. Musselman is manager.

PHILADELPHIA, PA.—The General Carbonic Company, North Third Street, has awarded contract to H. McCloskey, Jr., 1620 Thompson Street, for the erection of a two-story power plant and garage building at 842 North Third Street.

PHILADELPHIA, PA.—Contract has been awarded by the Colonial Mills Company, Lena and Armat Streets, to Walter Dalton, Heed Building, for the erection of a power plant at its works.

PHILADELPHIA, PA.—Plans are under consideration by the Manufacturing Company of America, Twelfth and Hamilton Streets, for the installation of new boiler equipment in its power plant.

PHILADELPHIA, PA.—The American Manganese Bronze Company, Rhawn & Hegerman Streets, has awarded contract to Steward & Stevens, Ninth and Montgomery Streets, for construction of an addition to its power plant.

PHILADELPHIA, PA.—Contract has been awarded by the Philadelphia & Reading Railroad Company to H. L. Carhart, Penfield Building, Philadelphia, for the erection of a one and three-story signal tower and battery building at Myerstown, to cost about $25,000.

SCRANTON, PA.—Plans are being prepared by F. Koester, electrical engineer, for the construction of an electric power plant.

STEELTON, PA.—Arrangements have been completed by the Bethlehem Steel Company for the installation of a new motor-driven generator at its local steel mills. The present steam equipment will be discarded.

BALTIMORE, MD.—The American Sugar Refining Company, 117 Wall Street, New York, N. Y., is planning to establish a plant in Baltimore, which will involve an expenditure of about $8,000,000.

BALTIMORE, MD.—The Steinmetz Electric Mortor Car Corporation, recently incorporated with a capital stock of $2,000,000, is planning to erect a large factory for assembling motor cars. Dr. Charles P. Steinmetz, chief electrician of the General Electric Company, is to be chief engineer of the company.

OXFORD, MD.—The installation of a municipal electric light plant, to cost about $18,000, is under consideration by the town officials.

WESTON, W. VA.—Plans are under consideration by the Weston Milling Company for the erection of an electric transmission line to Seebert, to cost about $50,000. George I. Keener is president.

WIERTON, W. VA.—Arrangements, it is reported, have been made for a large extension to the blast furnace power station, providing for the installation of five 600-hp. boilers, equipped with underfeed stokers at the proposed new plant of the Wierton Steel Company. The equipment of the power plant will consist of two 7,500-kw. turbo-generator units, with switchboard and auxiliary apparatus for which contracts have been awarded.

RICHMOND, VA.—Plans are under consideration by the Virginia Railway & Power Company for extensions and improvements to its power plant and system, to cost about $1,100,000.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 26 for the elevator-door protective devices in the Department of the Interior at Washington, D. C. For details see Searchlight Section.

WASHINGTON, D. C.—The Potomac Electric Company has recently installed and put into service a 20,000-kw. General Electric turbine with a Worthington condenser in its Bennings plant; also two additional 1,000-hp. B. & W. boilers, equipped with Taylor stokers; 18 Taylor stokers have been installed on 12 of the 600-hp. B. & W. boilers, which were formerly equipped with natural draft stokers. A new intake chamber to condense the water has been completed in which four rex revolving screens have been installed. An extension was made to the turbine room to provide space for the generating unit. This work was designed and carried out under the direction of Francis R. Weller, Hibbs Building, consulting engineer. R. L. Weide was engineer in charge of construction.

North Central States

CHARLOTTE, MICH.—The City Council is considering the question of equipping the municipal water works station with electrically-operated machinery.

DETROIT, MICH.—A new proposal for a municipally-owned street railway system, it is said, will be submitted to the City Council. The plan, sponsored by Mayor James Couzens, provides for the construction of about 140 miles of track to cover as nearly as possible every section of the city.

PETOSKEY, MICH.—Work, it is understood, will soon begin on the construction of the machine shop and power plant for the Petoskey Portland Cement Company. A. B. Klise is president.

CINCINNATI, OHIO. — Contracts will soon be awarded by the War Department, U. S. Engineer Office, Cincinnati, for the construction of a power house at Dam 35, Cincinnati.

DOVER, OHIO.—Bonds to the amount of $100,000 have been voted for extensions to the municipal electric light plant and to replace the natural gas engines now in use with steam engines.

FORT LORAMIE, OHIO.—The Fort Loramie Light & Power Company contemplates improvements to its plant, including the installation of three 10-kva. transformers; also the erection of 19 miles of bare copper line and the purchase of 50 Westinghouse meters and 12 lamps. Karl Schmeel is engineer in charge of the work. W. J. Sherman is manager.

KENTON, OHIO.—New equipment is being installed in the plant of the Hardin-Wyandot Lighting Company, including one 1,250-kva., Curtis turbine complete with No. 11 Le Blanc condensers and switchboard. P. M. Magly is manager.

LOUDONVILLE, OHIO.—The Board of Trustees contemplates the purchase of four 15-kva., three 10-kva. and two 5-kva., 2,300/110/220-volt General Electric transformers, 100 chestnut poles and 3 miles of No. 8 wire and 50 I-14, General Electric meters. Cleveland Bowen is superintendent.

WELLINGTON, OHIO.—New equipment, including two 330-hp. Heine boilers, two Murphy stokers and a 675-kw. General Electric steam turbine has been purchased for the municipal electric light plant. The Board of Commissioners is in the market for coal conveying equipment. Contract will be let in the spring for 14,000 ft. of 4-in. cast-iron water main. C. E. Gadfield is superintendent.

AUBURN, KY.—Surveys are being made by the Auburn Light & Water Company for the installation of an electric light plant in Auburn. The company was recently granted a franchise to operate here. The present address of the company is McCormack Building, Bowling Green. R. E. Turbville is manager.

INDIANAPOLIS, IND.—The Prest-O-Lite Company is planning to erect a battery house, to cost about $400,000.

KOKOMO, IND.—The Pittsburgh Plate Glass Company is planning the erection of a new power plant, to cost about $800,000. The company also contemplates the erection of 100 houses for its employees.

SYRACUSE, IND.—Plans, it is reported, have been approved by the Syracuse Light & Power Company and the Baltimore & Ohio Railroad Company for the construction of a dam next spring. The project is for the benefit of the Syracuse company.

CHICAGO, ILL.—Plans are under consideration by the Federal Electric Company for the erection of a new plant, to cost about $150,000.

CHICAGO, ILL.—Plans have been filed by the Jewel Electrical Instrument Company, 1650 Walnut Street, for the erection of a new building adjoining its present works, to cost about $50,000.

CHICAGO, ILL.—Plans have been filed by William G. Garvey, 38 Dearborn Street, Chicago, for the erection of a plant at 5008-18 Bloomingdale Street, for the manufacture of electrical products, to cost about $90,000.

LAWRENCEVILLE, ILL.—The Central Illinois Public Service Company is planning to erect a 33,000-volt transmission line from its Illinois terminus to Vincennes, Ind.

MAHOMET, ILL.—Contract has been awarded to H. P. Kruse of Champaign for the erection of a high-tension transmission line from Champaign to Mahomet, at $22,000. A distribution system will be installed in the village of Mahomet. Electricity will be supplied by the Urbana & Champaign Railway, Gas & Electric Company of Champaign.

PEORIA, ILL.—The installation of a power plant, to cost $22,000, at the Proctor Hospital is under consideration.

COLFAX, WIS.—The Colfax Light & Power Company is planning to increase the output of its hydro-electric plant, at a cost of about $200,000.

EAU CLAIRE, WIS.—The Chippewa Reservoir Company is planning to build a dam in the Chippewa River during the coming spring. P. D. Kline, general manager of the Wisconsin-Minnesota Light & Power Company of Eau Claire is interested in the project.

SHEBOYGAN, WIS.—The Citizens Telephone Company is considering the construction of additional conduit and serial cables, to cost about $85,000.

SHEBOYGAN, WIS.—The Sheboygan Fruit Box Company, North Fifteenth Street, is planning to build an addition to its factory and power plant, to cost about $40,000.

WARREN, WIS.—The Tomah (Wis.) Electric Light Company is contemplating extending its electric transmission lines to Warren to supply electricity for lamps and motors here.

BENSON, MINN.—Plans are being prepared for changing the municipal electric light plant from direct to alternating current. New equipment including a new generator, switchboard and boilers will be installed. The cost is estimated at about $40,000. W. E. Skinner, 15 South Fifth Street, Minneapolis, is engineer.

GONVICK, MINN.—The town officials have granted Allen & Johnson a franchise to install and operate an electric light plant in Gonvick.

MAQUOKETA, IOWA.—Bids will be received until Jan. 20 for $65,000 electric light bonds. D. T. Bauman is city clerk.

MASSENA, IOWA.—The installation of a municipal electric light plant is under consideration by the city officials.

BUFFALO, MO.—The installation of a new street lighting system in Buffalo is under consideration.

POPLAR BLUFF, MO.—Investigations are being made by M. R. Cole of prospective sites for a power dam at Butting Rock, near Eminence. It is estimated that a 30-ft. dam located at that point would develop sufficient power to meet the requirements in this section.

ESMOND, N. D.—Improvements are contemplated to the local electric light plant, including the installation of a 15-kw., three-wire, or a 250-volt, two-wire, direct current generator, one switchboard panel; also the purchase of one 300-volt meter, one 100-volt meter, 5,000 ft. No. 10 weatherproof copper wire, 10 direct-current, 5-amp. meters for 110-volt service, 1,000 25, 50, and 75-watt lamps. C. A. Page is owner.

MILTON, N. D.—Bids will be received by the village of Milton until Jan. 14, for furnishing and installing an oil engine, generators, switchboard and distribution system for the municipal electric plant. Hans Berg is village clerk.

PEMBINA, N. D.—The Pembina Light & Power Company is installing a new 150-hp. unit in its plant. E. J. Teberg of Minneapolis, Minn., who has purchased the interest of H. R. Robowski, president, will take charge of the property.

GARRETSON, S. D.—The Council is considering calling an election to submit the proposal to sell the municipal electric light plant to Ralph Gardner. The installation of a new engine in the plant is also under consideration.

ROMONA, S. D.—Plans are under consideration for the installation of a municipal electric lighting system. The project includes the erection of transmission line to Oldham.

MERIDIAN, KAN.—Plans are under consideration for rebuilding the transmission line to Topeka a distance of 15 miles. W. B. Rollins, Railway Exchange Building, Kansas City, Mo., is consulting engineer.

NEODESHA, KAN.—Plans are under consideration by the Standard Oil Company, of Kansas, 5301 East Ninth Street, Kansas City, Mo., for the construction of a new refinery in Neodesha, to include 42 additional stills, boiler house, etc., at a cost of about $1,500,000.

NESS CITY, KAN.—Bonds to the amount of $50,000 have been voted for extensions to the municipal electric light plant. New equipment, including a 250-hp. engine and generator and other apparatus will be installed.

Southern States

BUCKNER, N. C.—The Green Light & Power Company of Pleasant Hill, contemplates extending its transmission lines to Buckner to furnish electrical service here. The street lighting system will consist of 24 lamps.

EDENTON, N. C.—New equipment will be installed in the municipal electric light plant, including the installation of a 150-hp. return tubular boiler, one 500-kw. General Electric turbo-generator set, transformers, etc. All machinery has been purchased. J. C. Martin is superintendent.

GUILFORD COLLEGE, N. C.—The North Carolina Public Service Company of Greensboro has contracted with Guilford College to supply electricity here. An electric transmission line will be erected from Greensboro to the college, between 3 and 4 miles long.

HERTFORD, N. C.—A bond issue of $125,000 for extensions and improvements to the municipal electric light plant and waterworks system has been approved by the Board of Trustees.

LAKEVIEW, N. C.—The Electric Light & Power Company has filed an amendment to its charter increasing its capital stock from $75,000 to $300,000. The company contemplates extensions and improvements to its plant. J. R. McQueen is president.

CARTHAGE, TENN.—The Smith County Electric Company has nearly completed the erection of an 11,000-volt transmission line to Gordonsville, Hickman and Brush Creek. R. S. Seese is manager.

BIRMINGHAM, ALA. — Arrangements have been completed by the Gulf Steel Company for increasing the output of its power plant from 3,000 to 7,000 kw.

NORTH BIRMINGHAM, ALA.—Ground has been broken for the construction of a large power plant to be erected in connection with the local by-products works of the Sloss-Sheffield Steel & Iron Company, now under construction.

CLARKSDALE, MISS. — Improvements are contemplated to the municipal electric light plant, including the installation of a 1,500-kw. turbo-generator, condenser, cooling apparatus, boiler, feed pump, for which bids will be received until Jan. 13. Walter S. Bobo is city engineer.

ARKANSAS CITY, ARK.—The Lambe & Denmarke Water & Light Company is contemplating the purchase of oil engines and other equipment.

MAGNOLIA, ARK.—Steps have been taken to organize a company to construct and operate electric light, water and ice plant. The company will be capitalized at from $75,000 to $100,000. Samuel Grason is reported interested in the project.

LAFAYETTE, LA.—The City Trustees are considering improvements to the municipal electric light plant and waterworks system.

NEW ORLEANS, LA.—The New Orleans Railway & Light Company contemplates extensions and improvements to its power house.

ARDMORE, OKLA.—The Consumers Light & Power Company is considering the installation of one 500-hp. Heine boiler and one 2,000-kw. General Electric Steam turbine. William A. Baehr of Chicago, Ill., is engineer in charge. J. F. Pritchard is general superintendent.

BROKEN BOW, OKLA.—The City Council is considering the construction of a municipal electric light plant, to cost about $135,000. The Hughes Engineering Company, Bank of Commerce Building, Tulsa, is engineer.

BYRON, OKLA.—Bonds have been authorized for the establishment of a municipal electric light plant in Byron.

CHANDLER, OKLA.—The Chandler Electric Company contemplates the purchase of a 200-hp. steam engine and one car load of poles. C. E. Kapp is manager.

DRUMRIGHT, OKLA.—The Oklahoma Gas & Electric Company contemplates the purchase of materials for 22 miles of overhead transmission lines and 500 meters for 60-cycle, alternating-current service. The Byllesby Engineering and Management Corporation, 208 La Salle Street, Chicago, Ill., has charge of the work. W. B. Miser is manager.

SALLISAW, OKLA.—Improvements are contemplated to the municipal electric light plant, including the installation of one 150-hp. boiler, one 250-hp. steam engine, one 250-kva. 60-cycle, alternating-current generator and switchboard equipment complete. Fred E. Johnston is city manager.

STROUD, OKLA. — Improvements are contemplated to the municipal electric light plant, including the installation of an oil or gas engine from 125 to 150-hp., one 90 to 125-kw. three-phase, 60-cycle, 2,300-volt generator. Bonds have been voted by the city for water and light extensions and the construction of a 10-ton ice plant, equipped with electric motor-driven machinery. The equipment will be purchased within the next 60 days. The city would like to receive estimates and prices on same. W. A. Hadley is chairman of board of trustees. John A. Walker is manager of the plant.

GAINESVILLE, TEX.—The Gainesville-Sherman Traction Company has submitted proposals to the citizens of Gainesville, Whitesboro and Sherman looking to the

construction of an interurban electric railway between Gainesville and Sherman, a distance of 30 miles. Burt C. Blanton of Dallas is general manager.

GOOSE CREEK, TEX.—The Humble (Tex.) Oil & Refinery Company, it is reported, contemplates the construction of an electric power station and transmission system, to cost about $500,000.

GOOSE CREEK, TEX.—The Gulf Production Company of Houston is planning to erect two large electric power plants and electric transmission system, to cost about $500,000, in connection with its works.

GOOSE CREEK, TEX.—The Goose Creek Light & Power Company, recently incorporated, is planning to build an electric light and power plant in Goose Creek. The company is capitalized at $75,000. W. W. Sloan, R. S. Sterling and T. D. Joiner, Jr., are among the incorporators.

HONDO, TEX.—The Hondo Light, Power & Ice Company contemplates the purchase of one second-hand boiler, and probably a steam engine and electric generator with switchboard equipment. A. G. Walker is manager.

PITTSBURG, TEX.—Improvements are contemplated to the plant of the Home Light & Ice Company, to cost about $30,000. New equipment, including motor-driven ice making machinery, boilers, etc., will be installed.

PRYOR, OKLA.—The City Council has engaged V. V. Long & Company, engineers, Colcord Building, Oklahoma City, to prepare preliminary plans for construction of water purification plant, pumping station and electric transmission line.

Pacific and Mountain States

FRIDAY HARBOR, WASH.—The property of the Friday Harbor Light & Power Company has been purchased by L. T. Mulvaney.

ROSEBURG, ORE.—A special election will soon be held to submit to the voters the proposal to establish a municipal electric plant. Surveys are now being made by the Engineering Department of the city of the proposed site at Rock Creek.

MODESTO, CAL.—Petitions calling for a special election to vote on the proposal to issue $2,000,000 in bonds for the Modesto Irrigation District's share in the construction of the Don Pedro reservoir, power plant and transmission and distribution system and the enlargement of the present canal are being circulated.

YUMA, COL.—Bids will be received by the Town Council until Jan. 19 for construction of a steam-driven electric light and power plant, to cost about $50,000. R. D. Salisbury, 1415 East Colfax Avenue, is engineer.

Canada

WINNIPEG, MAN. — Bonds to the amount of $500,000 have been sold by the Provincial Government, the proceeds to be used for improvements to the telephone service. Automatic telephones will be installed in Winnipeg and St. Boniface.

BELLEVILLE, ONT.—The Tivani Electric Steel Company is planning to erect a foundry and build piers in Belleville. The cost of the buildings is estimated at $250,000 and the reduction furnaces and rolling mills, $4,000,000. Hamilton and Hensall, 13 Park Row, New York, N. Y., are consulting engineers.

CAPREOL, ONT.—A by-law to provide $20,000 for the construction of an electric light plant in Capreol will be submitted to the ratepayers on Jan. 15.

FORT METACHEWAN, ONT.—A British syndicate, it is reported, contemplates a power development at Fort Metachewan, to cost about $250,000. Sutcliffe & Neelands of New Liskeard, are engineers.

KINCARDINE, ONT.—At the January municipal elections the proposal to provide $40,000 for the installation of a Hydro-Electric power system and to rebuild the electric lighting system will be submitted to the ratepayers.

LONDON, ONT.—Surveys are being made by the Hydro-radial surveyors for the proposed railway which is to run from Brantford East, and will enter London via the London & Port Stanley Railway, by making connections at a point 5 miles south of the city.

MERRILTON, ONT. — The Canadian Steel & Forging Company contemplates extensions to its steel plant and also to its hydro-electric power, lighting and heating plants, to cost about $200,000. J. J. Wernette, Housman Building, Grand Rapids, Mich., is engineer.

PETERBORO, ONT. — The Canadian Alladin Company, Canadian Pacific Railway Building, Toronto, contemplates the construction of an electric light plant in Peterboro, to cost about $75,000.

STOUFFVILLE, ONT.—A by-law to authorize $20,000 for the purpose of erecting an electric transmission line to connect the village with the Metropolitan line at Bond Lake, a distance of 7 miles, will be submitted to the ratepayers at the municipal election.

THOMAS, ONT.—Contracts will soon be awarded by W. C. Miller, city engineer, for furnishing and installing electric and gasoline auxiliary pumping equipment for waterworks station, to cost about $20,000.

WHITECHURCH, ONT.—The Township Council has approved a by-law authorizing the village of Stouffville to erect an electric transmission line between the townships of Markham and Whitechurch, from Yonge Street to Stouffville.

MONTREAL, QUE.—Plans are under consideration by the City Commission for the installation of two electrically-driven pumps of 25,000,000 gal. daily capacity at the city pumping station next spring. The cost of the pumps is estimated at $75,000.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 14 for telephone cable. Blanks and general information relating to this circular (1328) may be had at the above office.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until Jan. 24, for electric freight elevator, refrigerating plants, steel rollers, annunciators, panel boards, push buttons, copper cable, conduits, duct tile, lighting fixtures, switches, transformers, terminal tubes, magnet wire, screws, etc. Blanks and information relating to this circular (1329) may be obtained at the above office, or the office of the assistant purchasing agent, 24 State Street, New York, N. Y.; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 23, 1919)

1,325,521. IGNITION-LOCK FOR MOTOR-VEHICLE; Alf Landgren and Max B. Ewers, Highland Park, Mich. App. filed Jan. 17, 1918. Short-circuit prevents theft.

1,325,539. ELECTRIC FURNACE; Frederick T. Snyder, Oak Park, Ill. App. filed Mar. 1, 1917. Reduces air leakage.

1,325,554. MEANS FOR LOCATING ORE BODIES BY AUDIO-FREQUENCY CURRENTS; Wendell L. Carlson and Earl C. Hanson, Washington, D. C. App. filed May 7, 1919. Exploring coil in balanced electrical circuit.

1,325,559. VAPORIZER; Luis E. Eckelmann, New York, N. Y. App. filed April 26, 1918. Liquid heated before discharged onto vaporizing surface.

1,325,574. SECRET-SIGNALING SYSTEM; Harold William Nichols, Maplewood, N. J. App. filed Sept. 11, 1915. Distorts signals transmitted.

1,325,597. AUTOMATIC ELECTRIC REGULATOR; William A. Turbayne, Niagara Falls, N. Y. App. filed June 29, 1914. Maintains predetermined current for carlighting systems.

1,325,598. SYSTEM OF ELECTRICAL REGULATION; William A. Turbayne, Niagara Falls, N. Y. App. filed Dec. 11, 1915. Vibrating relay type for battery work.

1,325,653. STORAGE-BATTERY CELL; Lee J. Perry, Chicago, Ill. App. filed Mar. 10, 1916. Interlocks cell plates.

1,325,655. SWITCH MECHANISM; Julius H. Richards, Newark, N. J. App. filed Dec. 2, 1916. For automobile starting system.

1,325,677. COMBINED STARTER AND LIGHTING DYNAMO; Albert Henry Midgley, Acton Vale, Eng. App. filed Jan. 29, 1917. Cutout between two brushes of same polarity.

1,325,698. AUXILIARY FUSE-CLIP; Edward B. Milloy, Detroit, Mich. App. filed Oct. 14, 1918. For firm contact.

1,325,709. INSULATING ELECTRICAL CONDUCTOR; Bela Bognar, New York, N. Y. App. filed Nov. 15, 1918. Inexpensive insulating material, hard, tough and flexible.

1,325,710. BATTERY-PLATE ENVELOPE; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed April 16, 1913. Envelope integral with plate.

1,325,763. FLOW-METER; Jacob M. Spitzglass, Chicago, Ill. App. filed May 19, 1915. Pressure difference in U-tube actuates ammeter and water meter.

1,325,823. ELECTRIC CLOCK; Hihohichi Abe, Yamagata-Ken, Japan. App. filed Mar. 6, 1918. Operates accurately regardless of the electromagnet current intensity.

1,325,862. ELECTRIC CLOCK; Arthur F. Poole, Kenilworth, Ill. App. filed June 11, 1917. Conical pendulum swings in circle.

1,325,865. VACUUM-TUBE SOCKET; Herbert E. Shreeve, Wyoming, N. J. App. filed May 20, 1916. For audion.

1,325,866. VENT FOR STORAGE BATTERIES; Thomas Spencer, Philadelphia, Penn. App. filed Nov. 26, 1915. Prevents overfilling jar.

1,325,871. TELEPHONE SYSTEM; Charles W. Keckler, Newark, N. J. App. filed May 24, 1917. Electromagnetic control of calling station with called station.

1,325,875. ELECTRIC-LAMP SOCKET; Alexander W. Limont, Bridgeport, Conn. App. App. filed Mar. 3, 1919. Corrugated shell.

1,325,879. VACUUM-TUBE CIRCUITS; Harold W. Nichols, Maplewood, N. J. App. filed Dec. 28, 1916. Prevents undesirable capacity effects between electrodes.

1,325,885. SIGNAL DEVICE; Charles Weber, Newark, N. J. App. filed May 22, 1919. Hand flashlight.

1,325,889. PROTECTOR FOR ELECTRIC CIRCUITS; Austen M. Curtis, Brooklyn, N. Y. App. filed Nov. 1, 1915. Diverts power around receiving circuit.

1,325,899. HANGER FOR CONDUCTOR WIRES; John T. Morgan, Charleston, West Virginia. App. filed June 6, 1917. Conductor supported without tension.

1,325,914. LIFTING MAGNET; Lewis D. Rowell, Milwaukee, Wis. App. filed Oct. 7, 1907. Load concentrated as released.

1,325,937. MOTOR-CUSHIONING DEVICE; Samuel Fox, New York, N. Y. App. filed May 7, 1918. Electric shoe polisher.

1,326,005. ELECTRICAL APPARATUS; Charles P. Steinmetz, Schenectady, N. Y. App. filed Jan. 14, 1915. Distribution of capacity in high-voltage transformer windings.

1,326,025. PNEUMATICALLY-OPERATED CONTROLLER; Frank E. Case, Schenectady, N. Y. App. filed July 10, 1918. For railway motors.

1,326,029. INCANDESCENT CATHODE DEVICE; William D. Collidge, Schenectady, N. Y. App. filed Dec. 4, 1917. For X-ray tubes.

1,326,036. SPARK INTENSIFIER; Mahlon L. Dunbar, Akron, O. App. filed Mar. 16, 1918. Adjusts length of gap.

1,326,049. ELECTRICAL APPARATUS; Frank C. Green, Pittsfield, Mass. App. filed Dec. 4, 1916. Prevents moisture in transformer oil.

1,326,$63. TROLLEY WHEEL; Frank C. Karkalla, Fairhaven, Penn. App. filed Sept. 20, 1916. Replaces trolley wire.

1,326,083. ARC-TYPE ELECTRIC FURNACE AND METHOD OF OPERATING THE SAME; William E. Moore, Pittsburgh, Penn. App. filed July 30, 1917. Two or more electrodes in polyphase formation.

1,326,104. METHOD FOR MODIFYING THE ELECTRICAL CHARGE OF DIAPHRAGMS; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed Nov. 16, 1914. Alters degree of absorption.

1,326,106. PROCESS OF TREATING COLLOIDAL AND FINELY SUBDIVIDED SUBSTANCES; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed June 19, 1912. Subjects colloidal matter to electro-osmosis.

1,326,120. INDUCTION FURNACE; Magnus Unger, Pittsfield, Mass. App. filed April 21, 1919. Primary winding located above charge container.